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Recent Warships for the French Admiralty

Two noteworthy launches took place in France during the latter part of 1912. On September 28 the battleship *Paris* was launched from the yards of the Forges et Chantiers de la Mediterranée, La Seyne near Toulon, and on Nov. 7 the battleship *France* was launched from the yards of the Ateliers et Chantiers de la Loire, St. Nazaire. The *Paris* and *France* are sister ships, both of which were laid down in August, 1911, and are to be completed in 1914. Their principal dimensions are:

Length between perpendiculars	541 feet 4 inches.
Breadth	88 feet 7 inches.
Maximum draft	29 feet 7 inches.
Displacement at full load	23,457 tons.
Brake horsepower	28,000
Designed speed	20 knots.

They are to be driven by Parsons turbines actuating four propellers. The normal supply of coal will be 900 tons and the maximum 2,700 tons. There will also be provided 1,000 tons of fuel oil, giving the vessels a steaming radius of 8,400 miles at 10 knots and 2,300 miles at 20 knots. The armament consists of twelve 12-inch guns placed in six turrets, two forward and two aft and one on either broadside amidships. The secondary armament consists of twenty-two 5.5-inch quick-firing guns. There are four 18-inch submerged torpedo tubes. The vessels are well armored, the main belt amidships having a maximum thickness of 11 inches, which is reduced to a minimum of 7 inches at the bow and stern. The turrets and conning tower are protected by 12-inch armor.

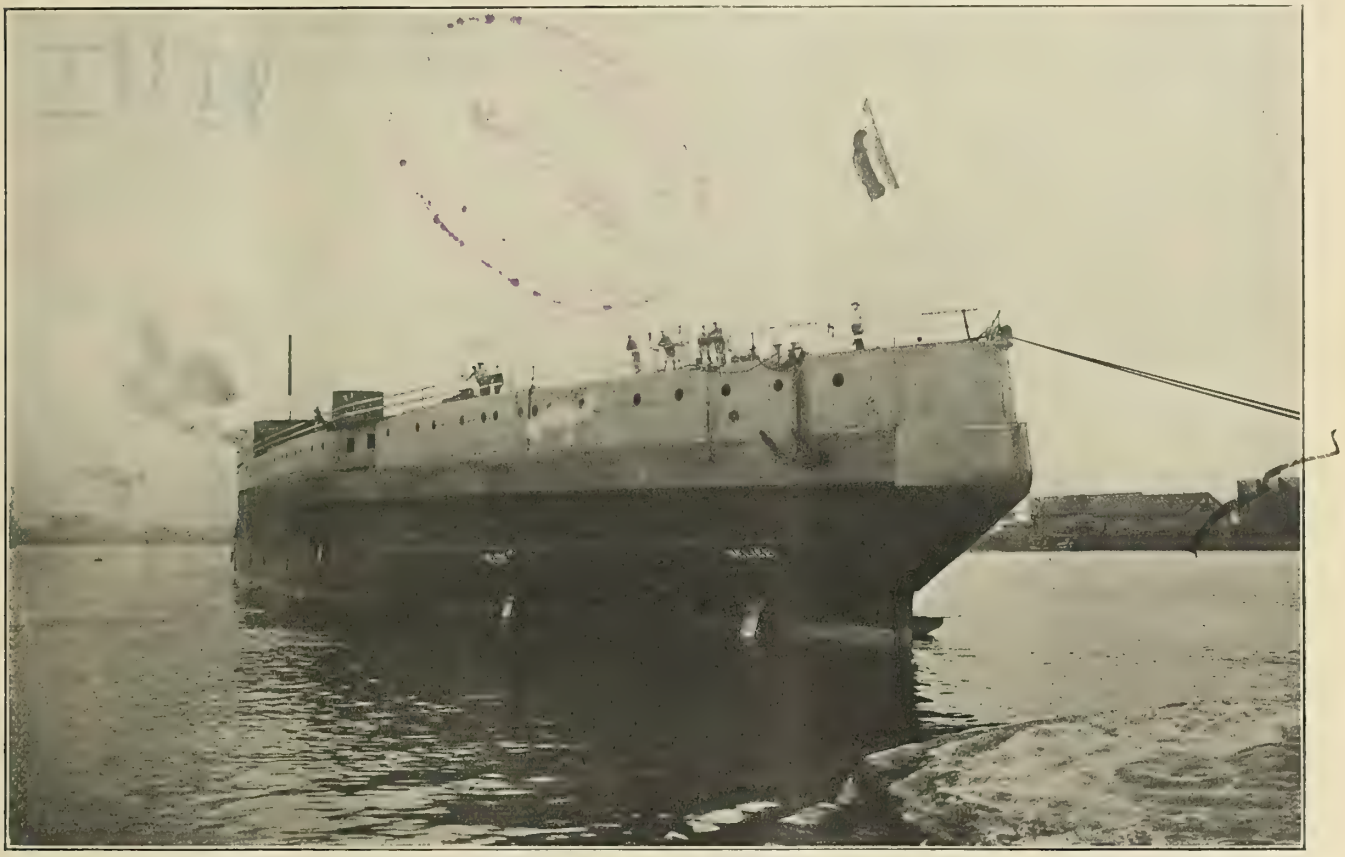


FIG. 1.—STERN VIEW OF THE BATTLESHIP FRANCE

Both launches were of particular interest because they were carried out by entirely different methods—the *Paris* was launched according to English practice and the *France* according to the custom of the yards in which she was built. The former, or English method, is recognized as being the safer, but also the more costly. The second method is much quicker and less expensive, but is more hazardous.

At the Mediterranean works the vessel is always carried in a cradle resting on two sliding ways, and therefore has great

stability during the launching, together with a minimum possibility of accident. The sliding ways built for the *Paris* had a total length of 423 feet and a breadth of 6 feet 7 inches, the declivity being 75 in 1,000. The total weight of both the ship and the cradle in this case was nearly 8,000 tons. Each forward poppet was strongly built of wood securely fastened outside the hull plating by round bar stays worked below the keel and fastened to the sliding ways on each side. The lower part of the poppets was designed as a curved bearing surface having a large radius. The cradle also at its upper part had a corresponding curved surface, so that when the stern of the ship became water-borne the forward part of the ship was pivoted by means of the curved surfaces between the cradle and the poppets at the exact point where the maximum stress occurred. The forward poppets had been so constructed as to safely withstand a stress of 1,000 tons per poppet. This method of launching worked perfectly, and the launching was satisfactory in every way.

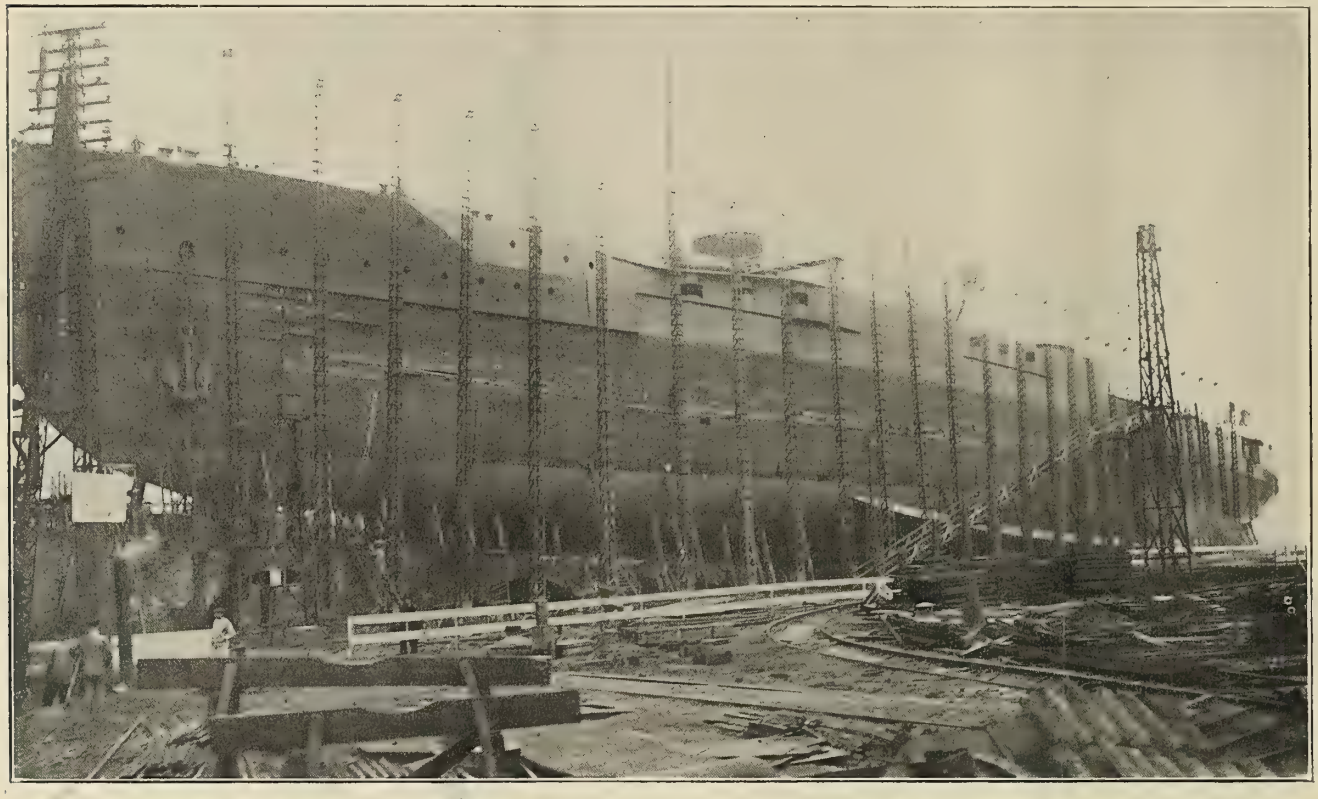


FIG. 2.—BATTLESHIP FRANCE ON THE BUILDING WAYS

The apparatus used to check the vessel on leaving the ways consisted of two sets of chains on each side, the first sets weighing 35 tons each and the second sets 45 tons each. They were connected to the ship by wire hawsers. The first set of chains was to be dragged as soon as the bow of the ship was about 180 feet from the shore, and the second chains were to come into effect after the ship had traveled about 30 feet more. It was expected that the effect of these chains, weighing altogether 160 tons, would stop the ship at about 100 yards from the shore. Owing to the bad weather experienced at the time of the launching, the ship dragged her chains further than the limit expected, and she was finally brought to rest by anchoring about 200 yards from the shore, where she awaited her tugs.

Launch of Battleship France

The *France* was launched in an entirely different way. In this case only a single sliding way was used—that is to say, the entire weight of the ship was sustained at her keel, which was supported on a single sliding way which was 4 feet wide, 10 inches thick and 395 feet long. Of course two additional ways were provided, one under each bilge beneath the docking keels of the ship, which were relied upon as an emergency arrangement in case the ship should become stalled on the ways. No drags of any kind were used to stop the ship, but when she was about 500 yards from the shore her anchors were let go. The weight of the *France* at the time of launching was 7,750 tons. The declivity of the ways was 60 in 1,000, and only 80 seconds were required from the time when she began to move on the ways until she was entirely afloat.

Destroyer Fourche

The destroyer *Fourche* belongs to a group of fourteen 750-ton destroyers ordered in 1910 and 1911 from the dockyards and private yards. The *Fourche* is in every respect a very noteworthy boat, not only on account of her successful trials recently carried out, but because she has been built as a whole strictly according to French design. The boldness with which the lines in the hull have been developed is noteworthy. The hull is an improvement of the *Voltigeur* design described in the July, 1910, number of International Marine Engineering, and is based on the builders' experiments, carried out in the Nantes yard. The turbines for this destroyer have been designed according to Mr. Rateau's arrangement and improved by the Chantiers de Bretagne. The Rateau-Chantiers de Bretagne turbines, together with the Breguet turbines, are the only two turbines of pure French design.

The destroyer has the following particulars:

Length over all	247 feet 11 inches.
Length between perpendiculars	245 feet 11 inches.
Breadth	25 feet 1 inch.
Depth	15 feet 11 inches.
Draft at stern	9 feet 7 inches
Displacement on trials	755.3 tons.

The hull is built of high tensile steel with special longitudinal stiffening. It is divided into ten watertight compartments, stanchions and heavy longitudinal members being

worked in all places where the hull and deck are required to sustain extra weights, especially where guns and torpedo tubes are located.

The hull is clincher riveted, the frames being of galvanized steel spaced 2 feet. Bilge keels have been worked on both sides of the hull about one-half the length of the ship. A strong wooden fender has also been worked on both sides of the ship and for about three-quarters of her length. The stem is of forged steel and the stern post and shaft bearings of cast steel. The rudder is of cast steel covered with galvanized plates. The rudder stock is of forged steel. As can be seen from the photographs, the rudder is located under the hull and is, therefore, well protected.

FIG. 3.—DESTROYER FOURCHE ON TRIAL TRIP

The general arrangement of the *Fourche* is as follows: Forward is the collision compartment; the next two compartments aft of this contain the crew's quarters, while below them are storerooms, fresh water tanks, an ammunition room and chain locker. The fourth and fifth compartments are the boiler rooms, each containing two Du Temple watertube boilers fired with mazout fuel oil, together with the fire-room auxiliaries. The liquid fuel is stored in thwartship tanks and also in the bottom tanks. Fresh water tanks have also been worked on both sides of the hull.

The propelling machinery is located in the sixth and seventh compartments. In the sixth compartment is the turbine driving the starboard propeller, together with its condenser and Westinghouse Le Blanc air pumps, etc. There are also two electric generators operated by Sabathé heavy oil motors, an evaporator, bilge pumps, oil pumps for forced lubrication, etc. In the seventh compartment is located the turbine driving the port propeller with its auxiliaries, and also an air compressor, a refrigerating plant, a forced lubricating plant and oil tank.

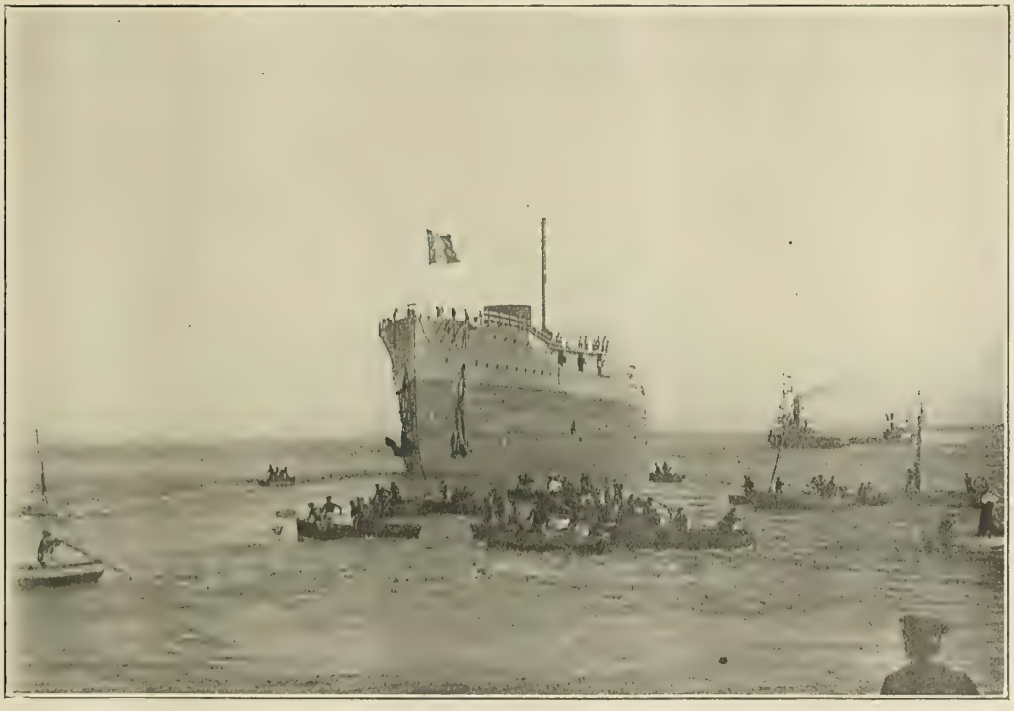


FIG. 4.—LAUNCH OF THE FRANCE

The eighth compartment is devoted to the officers' accommodations, the petty officers are berthed in the ninth compart-

ment, together with the wireless station, while the tenth compartment is a storeroom. Below the eighth and ninth compartments are the ammunition rooms for the guns and torpedo tubes.

The lines of the 750-ton destroyers were designed especially to give better sea-going qualities than previous destroyers for the French navy. The older boats were found to have too

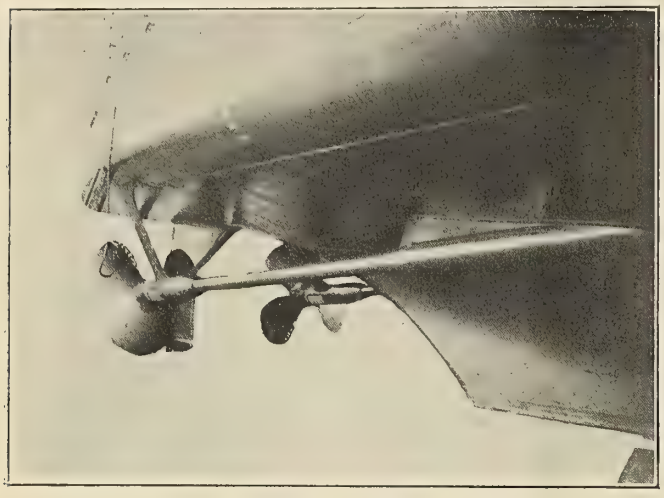


FIG. 5.—STERN OF DESTROYER FOURCHE

little freeboard forward when they met with a rough sea, and under such conditions they were obliged to run at reduced speed in order to avoid heavy damages; for this reason they were unable to make their designed speed except under favorable conditions. The *Fourche*, on the other hand, has a freeboard forward of 14 feet 9 inches and, with the added freeboard and improved design, this type of boat has been found serviceable and capable of good speed in rough weather. The armament of the *Fourche* consists of four 18-inch torpedo tubes located aft; two 4-inch quick-firing guns, one forward on the forecastle and the other aft; and four 2.5-inch quick-firing guns located two forward and two aft on each side.

Steam is supplied to the main engines and auxiliaries, as already stated, by four Du Temple watertube boilers fired with mazout fuel oil by Thornycroft burners. These boilers each have a heating surface of 5,167 square feet, the safety valves being set at a pressure of 228 pounds per square inch. At full power the boilers are operated under an air pressure of 7.2 inches of water.

The main engines consist of two marine turbines of the Rateau-Chantiers de Bretagne improved pattern located in two separate engine rooms. These turbines are, therefore, independent of each, and have the advantage that no cruising turbines are required, besides the elimination of complex piping arrangements. All speeds are obtained by the maneuvering of a single valve.

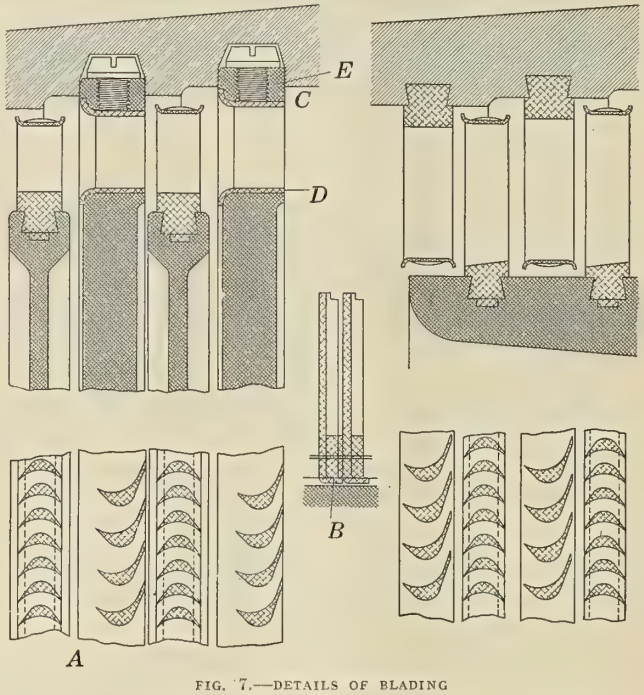


FIG. 7.—DETAILS OF BLADING

The Rateau-Chantiers de Bretagne marine turbines are of the impulse multi-cellular type, built so as to obtain on one shaft in one casing all powers required from slow cruising speed up to the maximum speed, as well as reversing, embodying, in fact, all of the maneuvering qualities of reciprocating engines. On the same shaft and in a single casing are mounted both the ahead and astern turbines, each turbine having blades designed for impulse working and being divided into high-pressure and low-pressure stages. The high-pressure is of large size compared with the low-pressure, and is built according to the multi-cellular system; that is, it is made up of a

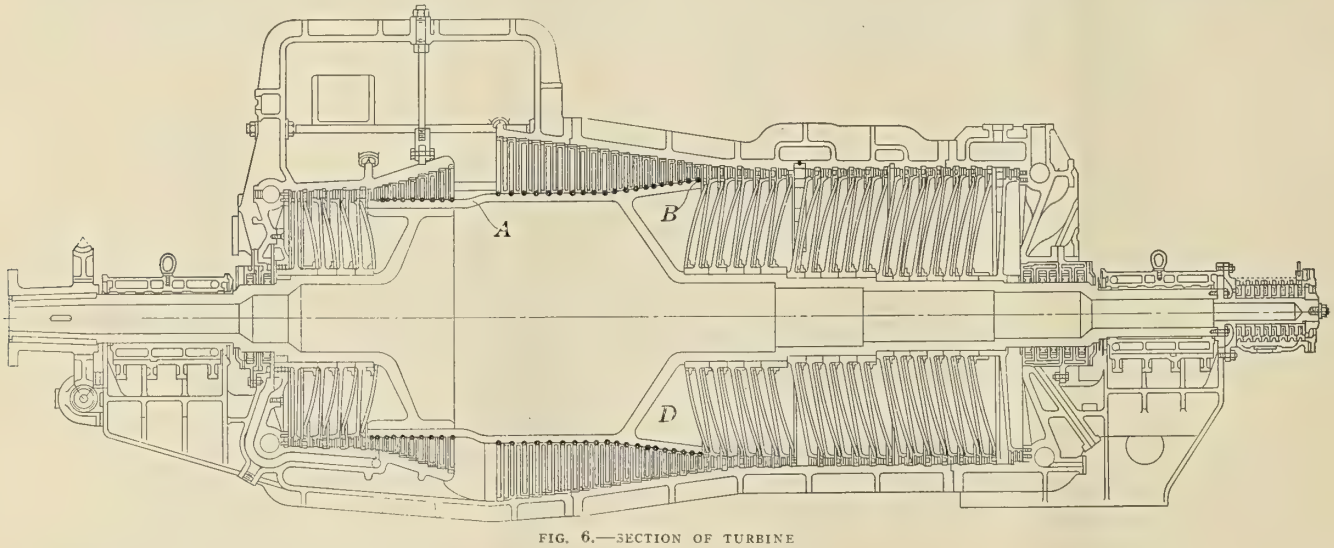


FIG. 6.—SECTION OF TURBINE

series of compartments corresponding to pressure stages in which are located wheels carrying several rows of blades, each wheel corresponding to a separate stage and especially calculated with the object of obtaining all required powers in the most economical way. Several valves have been provided in the turbine casing for the delivery of steam into the turbine, each of which represents a predetermined speed of rotation.

The maneuvering of a single hand wheel connected with the special steam valve is sufficient to start the engine or maneuver

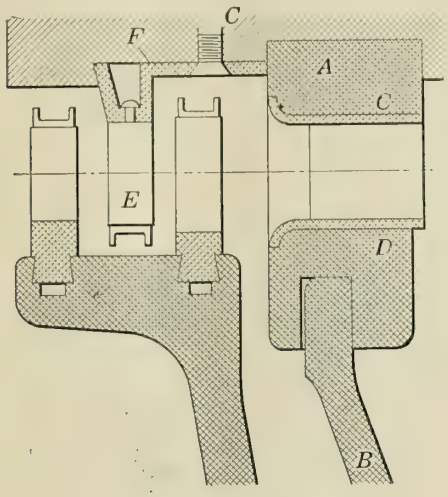


FIG. 8.—BLADING OF WHEEL

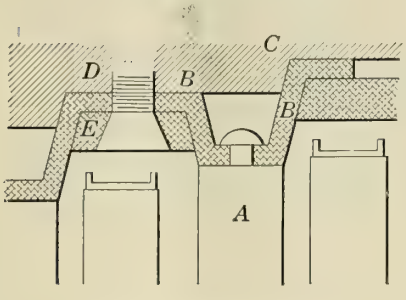


FIG. 9.—BLADING OF DRUM

from one speed to another, or to reverse from ahead to astern. Intermediate speeds are obtained by throttling the steam in order to reduce the pressure.

The low-pressure end of the turbine is built on a drum so as to reduce the weight and counterbalance the thrust of the propeller. The astern turbine is similar to the ahead turbine, but is built to develop only about 40 percent of the ahead power.

The main advantage of the mounting of velocity wheels in the high-pressure part of the turbine is that they answer perfectly to the partial admission of steam. The amount of leakage of steam where the shaft passes through the diaphragms is small and independent of the size of the blades. Moreover, the wheels with diaphragms do not cause any longitudinal thrust on the rotor, while the use of a drum in the high-pressure end of the turbine would require dummy rings or other delicate gear to counterbalance the thrust. The advantages obtained by the use of a drum on the low-pressure stage are that for a similar longitudinal space greater power can be developed by the drum with reaction blading, while the difference of pressure on the two faces of the drum gives a longitudinal thrust which may be regulated so as to counterbalance the thrust of the propeller to any required extent. The propeller thrust in the ahead turbine is counterbalanced by the pressure of steam on the face *B* of the low-pressure drum, while the other face, *C*, of the drum is subjected to the pressure of the condenser. A thrust bearing takes up any inequality in pressure and assures a perfect axial position of the wheels in the cells.

The following data were secured from the trial trips of the destroyers *Fourche* and her sister ship, the *Faux*:

SIX-HOUR FULL SPEED TRIAL

	Fourche.	Faux.
Contract speed	31 knots	31 knots
Contract fuel consumption per hour	12½ tons	12½ tons
Trial displacement	725 tons	722 tons
Draft	8 ft. 3 ins.	8 ft. 3 ins.
Steam pressure at boilers	228 pounds	228 pounds
Steam pressure at steam chest	171 pounds	171 pounds
Air pressure in stokehold	7.1 inches	7.1 inches
Fuel oil pressure at burners	185 pounds	192 pounds
Revolutions per minute, average	680	658
Mean speed	33.20 knots	32.01 knots
Maximum speed	33.60	34.90
Brake horsepower, average	18,500	18,500
Vacuum, inches	28.34	28.54
Fuel consumption per hour	10.23 tons	10 tons
Fuel consumption per square foot heating surface	1.12 pounds	1.09 pounds
Fuel consumption per brake horsepower	1.24 pounds	1.21 pounds
Knots per ton of fuel burned	3.19	3.13
Heating surface per B. H. P.	1.12 sq. ft.	1.12 sq. ft.
Surface of condensers per B. H. P.	.33 sq. ft.	.33 sq. ft.
Condition of weather	Smooth sea	Rough sea

EIGHT-HOUR ENDURANCE TRIAL

	Fourche.	Faux.
Contract speed	14 knots	14 knots
Trial displacement	725 tons	722 tons
Draft	8 ft. 3 ins.	8 ft. 3 ins.
Number of boilers under pressure	2	2
Mean pressure at boilers	228 pounds	228 pounds
Mean pressure at steam chest	114 pounds	114 pounds
Air pressure in stokehold	1 inch	1 inch
Fuel oil pressure at burners	114 pounds	114 pounds
Revolutions per minute	242	242
Mean speed	14 knots	14 knots
Vacuum	29.13 inches	29.13 inches
Fuel consumption per hour	2,005.6 pounds	1 ton
Knots per ton of liquid fuel	15.38	15.14

On her preliminary trials the *Faux* ran at an average speed of 33.374 knots, but on her official trials this high speed was not obtained on account of the rough weather and the foul condition of her hull, as the hull had not been scraped and painted for two months. If the full power trials of this vessel had been run under favorable conditions the builders feel confident that she would have attained an average speed of at least 34 knots.

Improvements to the White Star Liner Olympic.—The alterations which have been made to the White Star liner *Olympic* since the foundering of her sister ship, the *Titanic*, involve the introduction of an inner skin extending fore and aft in continuation of the double bottom at the margin plate from the bilge up to a point 5 feet above the 32-foot waterline. The space betwen the inner and outer skin is from 30 to 36 inches. The number of watertight bulkheads has also been increased and some of the bulkheads have been carried to a much greater height in the ship, making the margin of safety of the reconstructed ship far beyond all previously recognized standards. Similar safeguards are also being introduced in the new White Star triple-screw steamer *Britannic*, of 50,000 gross tons, now building at Belfast.

Launch of the Lorenzo.—The steamship *Lorenzo*, of the New York and Porto Rico Steamship Company, was launched at the yards of her builders, the Newport News Shipbuilding and Dry Dock Company, January 25. This is the fourth vessel built for the New York & Porto Rico Steamship Company by the Newport News Shipbuilding and Dry Dock Company from designs by and under the supervision of Theodore E. Ferris, naval architect, New York. The ship is an exact duplicate of the *Corozal, Montoso* and *Isabela*. The principal dimensions of these ships are: Length, 347.8 feet; beam, 46.7 feet; depth, 25 feet; gross tonnage, 3,063.

A Sample of Old-Time Engineering Skill

BY CHARLES S. LINCH

When one looks over the work of the early naval architects and marine engineers, he is forced to acknowledge with ever-increasing admiration the excellence of their engineering ability and judgment. They had no precedence to follow, and their work stands to-day a monument to their skill from every point of view. A sample of such work can be found in the ferryboat *Long Beach,* which was built in 1880 by the Harlan & Hollingsworth Company, Wilmington, Del., for the East River Ferry Company, New York. Through the courtesy of Mr. H. L. Des Anges, Marine Superintendent Long Island

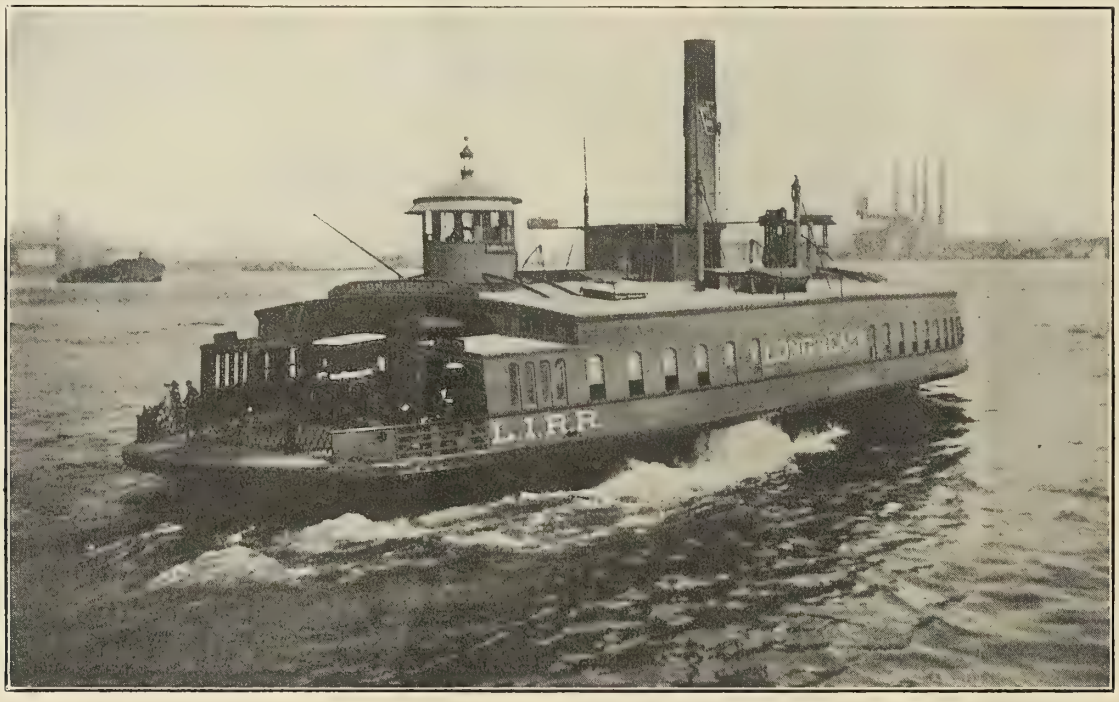


FIG. 1.—FERRYBOAT LONG BEACH LEAVING HER SLIP AT LONG ISLAND CITY

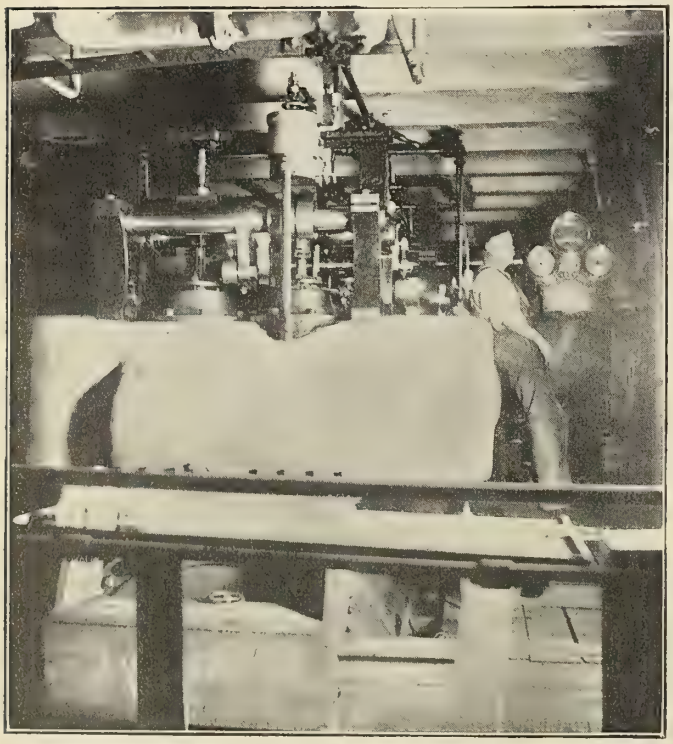


FIG. 2.—ENGINE ROOM OF LONG BEACH

Railroad, the writer is able to present a description and indicator diagrams from the engineers of this most interesting ferryboat.

The *Long Beach* is 150 feet long, 32 feet beam, 13 feet 6 inches depth, with a tonnage of 519.51. Steam is supplied by a horizontal cylindrical flue type boiler 28 feet long, 120 inches diameter, operated at a pressure of 40 pounds per square inch. The boiler contains 16 flues made up as follows: Six, 14 inches diameter, 14 feet 6 inches long; six, 14½ inches diameter, 11 feet 10 inches long; two, 23½ inches diameter, 11 feet 10 inches long, and two, 11½ inches diameter, 14 feet 6 inches long. There are two furnaces with a total grate area of 53.66 square feet.

The machinery of this boat is of particular interest. The engine is a single cylinder inclined jet-condensing engine with a cylinder 44 inches diameter and 9 feet stroke. The valves are of the poppet type, having Sickles cut-off gear on the steam valves. The air pump is driven from the engine crosshead through the medium of a vibrating lever, forked to permit the connecting rod to clear. The entire engine seating is built up of plates and angles, forming a part of the ship's structure. The cylinders, guides and main bearings are bolted to a sole plate which rests upon this seating, making a remarkably rigid structure, which is amply proved from the fact that all of the gear now in use is the original gear. The valves are bolted to seatings forming a part of the hull structure. There is one eccentric for ahead gear and one for astern. Fig. 2 is a photograph of the valve gear, showing clearly the dash pot on the

steam valve. The engine is handled in the same manner as the beam type. The starting bar is attached to the rock shaft. The lever at the back of the engineer is for the hook control for the ahead or astern gear. The small lever attached to the shaft whose bearings are dependent from deck beams, as can readily be seen, is for controlling the cut-off.

The dimensions of some of the important parts of the machinery are as follows:

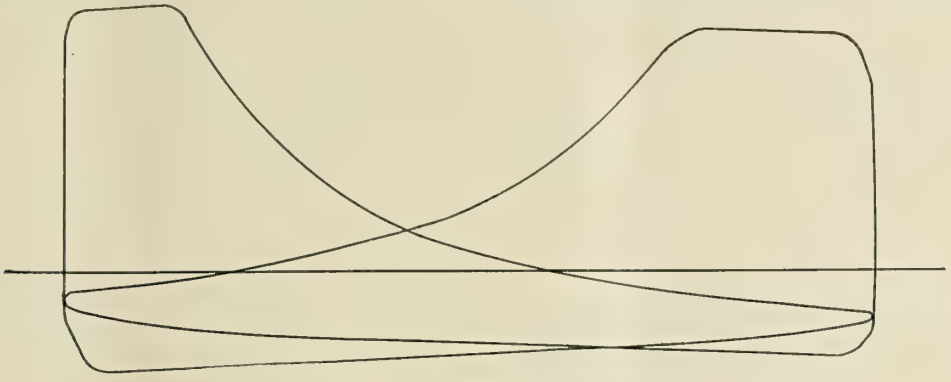


FIG. 3

Diameter of piston rod..... 5 3/16 inches.
Diameter of connecting rod, fork end..... 5⅜ inches.
Diameter of connecting rod, stub end..... 5⅜ inches.
Diameter of connecting rod, middle..... 7 7/16 inches.
Length of connecting rod..... 18 feet.
Diameter of crank pin..... 7 inches.
Diameter of shaft..... 13 inches.

The boat is propelled by side paddle wheels 18 feet 10 inches diameter, each wheel having 18 buckets 20 inches wide and 7 feet 2 inches long.

Assisted by the chief engineer of the line, Mr. James Overbaugh, the writer indicated this engine and obtained diagrams of which Figs. 3 and 4 were taken on the 12.48 P. M. and 1.12 P. M. runs, respectively. The scale of spring used in the indicator was 20 pounds.

From Fig. 4 the M. E. P. at the head end was 19.375 pounds and at the crank end 17.5 pounds, making the average M. E. P. 18.4375. The following conditions obtained at the time the diagrams shown in Fig. 4 were taken: The steam pressure at the boiler was 37 pounds per square inch gage and at the steam chest 30 pounds per square inch gage, making a drop between the boiler and steam chest of 7 pounds, and the absolute pressure at the same chest 45 pounds. The initial absolute pressure from the diagram at the crank end is 41.25 and at the head end 38.125, making the average initial pressure from the diagram 35.7 pounds, with a drop between the steam chest and piston of 5.3 pounds. There is, therefore, a loss of 5.3 pounds due to friction in passing through the valves and ports.

In Fig. 3 there is a difference of 16.875-15 or 1.875 pounds M. E. P. between the head and crank ends. In Fig. 4 there is a difference of 19.375-17.5, or 1.875 pounds M. E. P., between the head and crank ends. At the time the diagrams Fig. 3 were taken, the engine was working at 22 revolutions per minute, giving a piston speed of 396 feet per minute. The indicated horsepower developed at this time was 578.57.

At the time diagrams Fig. 4 were taken the engine was running at 24 revolutions per minute, giving a piston speed of 432 feet per minute, and an indicated horsepower of 729.

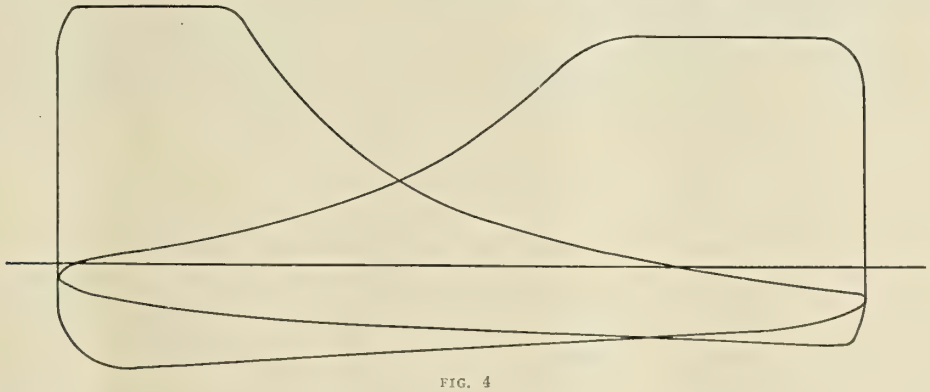


FIG. 4

Referring to Fig. 3 the M. E. P. at the head end was 16.876 pounds and the M. E. P. at the crank end 15 pounds, making an average M. E. P. of 15.93 pounds. The following conditions obtained at the time these diagrams were taken: The steam pressure at the boiler was 35 pounds per square inch gage, the steam pressure at the steam chest 28 pounds per square inch gage, making a drop between the boiler and steam chest of 7 pounds. The absolute pressure at the steam chest was 43 pounds. The initial absolute pressure from the diagram at the crank end is 41.875 and at the head end 40 pounds, making the average initial pressure from the diagrams 41 pounds, with a drop between the steam chest and piston of 2 pounds. The length of the steam pipe is 60 feet, and therefore there is a loss of 2 pounds, due from friction of the steam in passing through the valves and ports.

As these diagrams are reproduced full size, any further analysis desired can be made.

The kind of coal used on this service is low grade buckwheat rice, and the actual cost of fuel for this boat taken from reports is 21.13 cents per mile; labor, 56.24 cents per mile. The crew number six men, including one engineer, one fireman, one captain, two deck hands and one porter.

At the time the foregoing tests were made this boat was in daily operation, running from New York City to Long Island City. The number of hours was twenty-four per day under steam. This boat is thirty-two years old and the steam pressure carried has been cut only 10 pounds in this time. There are no patches on the boiler and the flues and all internal parts are in original condition. Furthermore, the engine cylinder has never been rebored.

The smoothness and ease of running is remarkable, there being no noise or vibration of hull, and unless one hears the bells it is impossible to tell when the engines are reversed. Again, in these engines the workmanship is of a superior grade, which is characteristic of the machinery built years ago and which to-day is conspicuous by its absence. With the old Harlan & Hollingsworth Company it was lose money rather than slight work, which in many instances was done. Not only was this true of this firm, but of the W. & A. Fletcher Company as well, as can be seen by an inspection of their work. The gages used on the boiler and on steam chest were test gages, the indicator was the American-Thompson visible spring type. Both the gages and indicator were manufactured by the American Steam Gauge & Valve Manufacturing Company, Boston, Mass. It is of interest to note further that the original gages and clock fitted when the boat was built were manufactured by the above company.

The turning moment of this engine is remarkably even, as can be proved by plotting same from the pressures taken from the diagrams shown. In certain service there is nothing yet built to equal these engines, or even the jet condenser. Space will not permit an extended analysis, but in the near future the writer will give the readers of this journal an analysis of tests made on compound engines of similar dimensions, one being fitted with surface, the other with jet condensers, and both used in same service, at which time the statement of economy will be proven.

The workmanship on the boiler of this boat is a thing of beauty, and in comparison with that on some of the boilers built within the last four years shows the superior workmanship which obtained thirty-two years ago. Compared on a tonnage basis, or the power required per square foot of wetted surface, there is a greater economy in these engines than in the compound or triple-expansion engine for the same service.

In conclusion, I would call the attention of the reader to the quick action of the valves; note the absence of excessive wire draw, the easy rounded corners and the absence of hump caused by reheating the expanded steam, the straight admission line, or, in other words, the admission line is nearly perpendicular to the atmospheric line. The compression is very small, and while the inertia effects of the reciprocating parts are small, yet with this small compression the engine is running with remarkable smoothness. The head end diagram, of course, shows the steam following a greater percentage of the stroke, and just sufficient to accomplish the result desired. Taken as a whole, it is one of the most interesting engines the writer has had the fortune to analyze, and all credit to those designers that have smoothed the path that we must follow. It would pay us to follow more closely and introduce that engineering judgment which every engineer worthy the name must or should have. The tendency to-day is to install engines of the most modern type for service in which they prove most uneconomical. That is to say, in certain service the compound or triple expansion engines, with their surface condensers and high steam pressures, light construction, etc., are not as satisfactory or economical as the lower steam pressures, jet condensers, with their reduced upkeep.

Since the above was written the *Long Beach* has been sold to the New Jersey and Delaware Ferry Company for service between Wilmington, Del., and Penn's Grove, N. J.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 79 sailing, steam and unrigged vessels of 24,402 gross tons built in the United States and officially numbered during the month of January. Over 77 percent of this tonnage was built on the Atlantic and Gulf coasts, six of the vessels being steel steamships, aggregating 11,430 gross tons.

A Menhaden Fishing Steamer

BY GEORGE A. DEAN, JR.

One of the most modern and best equipped menhaden fishing steamers hailing from a Virginia port went into commission in July, 1912. This steamer is the *Joseph F. Bellows*, owned and operated by Bellows & Squires, Inc., of Ocran, Va.

The hull and house are constructed of wood and are of the usual design for this class steamer. The lines of the hull are fine, with the primary idea of speed. In keeping, however, to the fine lines, neither the comfort of the crew nor the efficiency of the propelling machinery is sacrificed.

The general dimensions of the hull are: Length, 160 feet; beam, 22 feet 9 inches, and depth, 12 feet. The boat is lighted throughout by electricity and has a powerful searchlight on top of the pilot house. The crew's quarters are located in the forepeak, the engineers' and firemen's quarters are located on the main deck aft of the engine room, and the captain's and mates' quarters are on the upper deck aft of the wheel house. The galley is located on the main deck forward.

Hand-steering gear is used for handling the rudder. The rudder is made up of a steel frame and 10½-pound plates, and then cased in with 2½-inch oak planking, the claim being made that a vessel of this character handles much better and easier with a wood rudder. A galvanized hand brake windlass is located on the forward deck for handling two anchors, which are of 1,000 and 1,200 pounds, respectively. A 6-inch by 6-inch double cylinder friction gear hoisting engine is located in the forward part of the after house for bailing fish and other purposes.

The machinery outfit was built and installed by E. J. Codd Company, Baltimore, Md., and consists entirely of independent units. The boiler was built particularly large to insure free steaming under all conditions. It is of the single end Scotch type, 13½ feet diameter and 12 feet long, containing 296 3-inch charcoal iron tubes 9 feet long, three Morison corrugated furnaces 46 inches diameter, a steam drum 40 inches diameter by 60 inches long, and one common combustion chamber 30 inches wide. The boiler is designed to stand a working pressure of 160 pounds. A double stack 35 feet high, with hood, ruffle and bucket rack, is fitted to the smoke box of the boiler and guyed to eye bolts running from the top of the deck house to the underside of the house sill. All feed and blow valves, which are of extra heavy flanged pattern, are located on top of the boiler shell, in order to give easy access for handling.

The engine is of the two-cylinder inverted fore-and-aft compound type, 16½ inches by 33 inches by 24 inches stroke. It is of very heavy design, which is necessitated by the hard usage to which this class of machinery is subjected. The high-pressure valve is of the piston type, and the low-pressure a double-ported slide valve. The cylinders are separate castings and bolted together at the low-pressure steam chest, the joint being made of sheet copper. The high-pressure valve and the high and low-pressure cylinders are fitted with heavy liners made of the best grade close-grained cast iron. This arrangement precludes the possibility of ever having to make a new cylinder casting on account of wear, and after the liners have been bored and worn out they can be replaced with new ones.

The pistons are of cast iron fitted with snap rings, bull rings and followers. The cylinder heads are of cast iron turned and polished and are fitted with stuffing boxes for taking care of the tail rods.

The engine framing consists of two heavy cast iron columns in the rear and four polished forged steel columns in front. The use of the four columns in front proves a great benefit in decreasing vibration and also admits of better access to the cranks and bearings. The guides are of cast iron, hollowed

for water circulation, and are bolted to the cast iron columns. The crosshead slides are cast iron lined with Parsons white brass. The bed plate is of the drop pattern and cast in one piece.

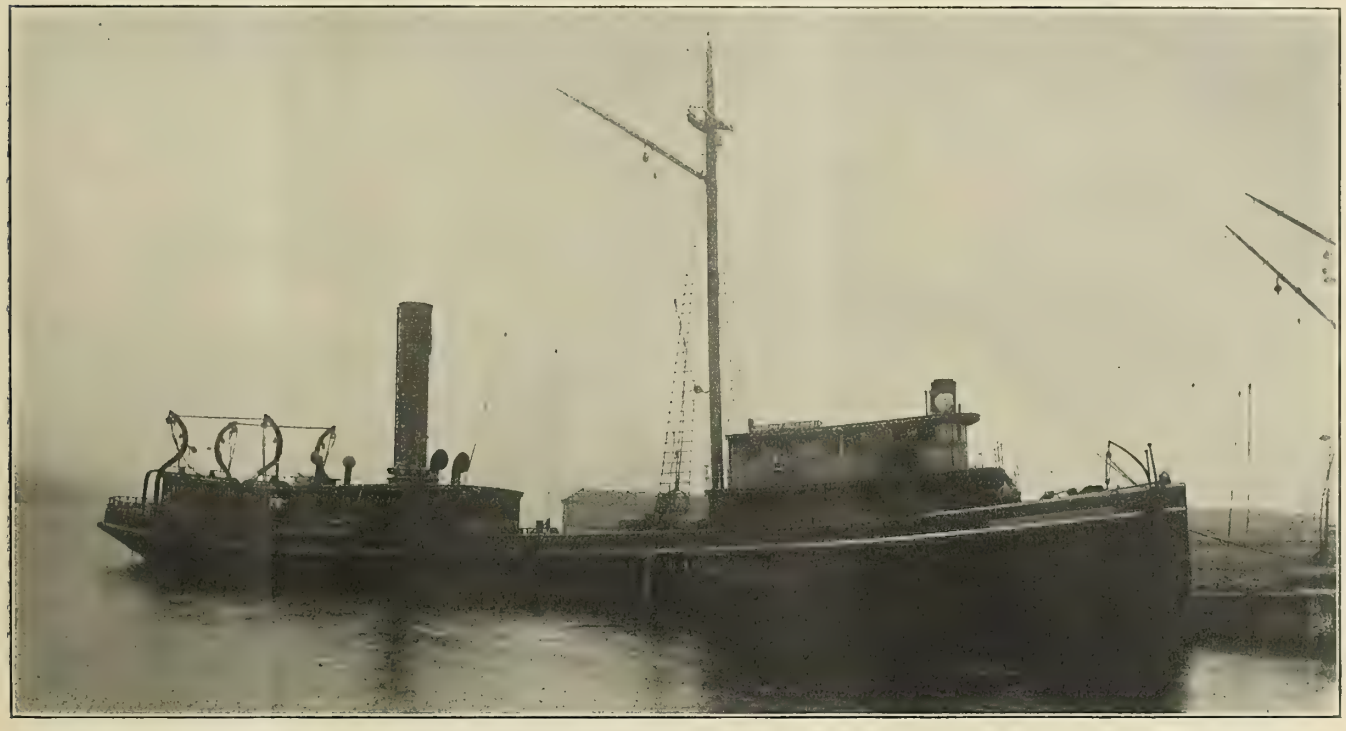
The valve gear is of the Stephenson link motion type, worked by a direct-acting steam reverse engine. Heavy phosphor bronze die blocks are fitted to the double bar links. The piston rods are made of special piston rod steel, and the connecting rods are of hammered iron; all other forgings are of mild steel.

The crank shaft is of the built-up type, 7¾ inches diameter. The pins and shaft are of forged steel, and the slabs, which are counterbalanced, are made of steel castings. The main bearings, four in number, are of ample length to give a good wearing surface; the bottoms of these bearings are of brass, and the tops, which also form the caps, are of cast iron; both top and bottom bearings are filled with Parsons white brass. The eccentrics are of cast iron, as also the straps, which are lined with Parsons white brass. All stuffing boxes about the engine are packed with France metallic packing.

The thrust is of the horseshoe type. The shoes are of cast iron, hollowed for water circulation, and are lined with Parsons white brass. The thrust shaft is an intermediate piece with solid collars turned on same. The tail shaft, which is 9 inches diameter, was made particularly large to take care of corrosion, which always deteriorates the shaft in close proximity to the brass sleeves. The stern bearing and stuffing box are of cast iron and bolted respectively to stern post and shaft log with Muntz metal pocket bolts and brass cap nuts. The propeller is of cast iron, 9 feet diameter by 11½ feet pitch.

The auxiliary outfit consists of one cylindrical shell surface condenser of 1,000 square feet cooling surface, one galvanized iron filter box, one 5-inch centrifugal circulating pump, one vertical beam double cylinder single-acting air pump, one 7-inch by 4½-inch by 8-inch duplex boiler feed pump, and one 7-inch by 4½-inch by 8-inch duplex donkey pump. A departure from general practice is used in connecting the two latter pumps. They are so connected that either one can perform the functions required of either the boiler feed or donkey pump. A 3-inch by 2-inch by 3-inch duplex pump is provided for circulating water through the guides and bearings and thence to the toilet, which is thereby kept constantly flushed. A bath tub is fitted aft for the convenience of the officers. A feed water heater made up of a cast iron shell and internal copper coils was designed and built by the builders of the machinery. All pipe valves and fittings in the connecting up of the main engine, auxiliaries and tanks are entirely of brass and copper, no iron pipe being used for any purpose.

The boiler being fired from forward permitted the building of large 'thwartship and side bunkers, the combined capacity being about 85 tons. The bunkers are constructed of 10½-pound steel plate and, in wake of the boiler, are arranged to be readily taken down. Beside having three bunker deck plates on each side of the house, there are also three forward of the after deck house, the quarter deck being extended to receive them. This prevents trimming and permits of very rapid coaling.



MENHADEN FISHING STEAMER JOSEPH F. BELLOWS

As this class of vessel is likely to be at sea for a number of days, one great essential necessary for the upkeep of the machinery is taken care of in the matter of fresh water. A combined tankage of 14,000 gallons is provided. One tank of 4,000 gallons is placed under the forepeak floor, two tanks of 3,000 gallons each are placed just forward of the forepeak and two tanks of 2,000 gallons each are placed in the stern. These tanks are so connected with the pumps that they can be pumped from forward to aft, or vice versa, and thereby can be used for ballasting or trimming. All of these tanks are provided with a 4-inch filling pipe on each side of the deck house. A hand deck pump is placed on the quarter deck aft, the suction of which is connected both to the bilge and sea and the discharge to the fire mains.

The vessel has completed a very successful season and has exceeded the expectations of both the owners and the builders.

Vessels Classed by Lloyd's Register.—Of the vessels launched during 1912, 596 of 1,625,527 tons were built under Lloyd's inspection with a view to classification by this society.

Single Screw Motor Ship of 1,500 B. H. P.

BY J. RENDELL WILSON

There is likely to be a great struggle for supremacy between the makers of the two stroke and four stroke marine Diesel engines. The technical press in general lean towards the two stroke motor as being the future type, but I am inclined to think that the conclusion has been drawn a little too hastily, as one has to consider that two of the prominent makers of four stroke engines in Western Europe have between them on order for ship propulsion alone motors totaling 35,000 brake horsepower, to be installed in vessels aggregating 97,685 tons deadweight capacity. I refer, of course, to Messrs. Burmeister & Wain, of Copenhagen, and the Nederlandsche Fabriek, Werkspoor, of Amsterdam. The former concern has on order a twin screw motor cargo and passenger motor ship of 4,000 indicated horsepower for the East Asiatic Company. This is the highest powered commercial vessel now building. All the numerous big Russian motor craft have four stroke engines, and although these vessels are running on inland waters, much important experience must have been gained. However, it is only fair to state that out of a total of 56 engineering firms no fewer than 40 have adopted the two stroke type Diesel. Despite this I think the four stroke Diesel will hold its own for several years yet, and is likely to prove the most reliable after driving a ship for a number of years. Because of the great number of firms building two stroke engines, this type, however, will be built to a greater extent in time.

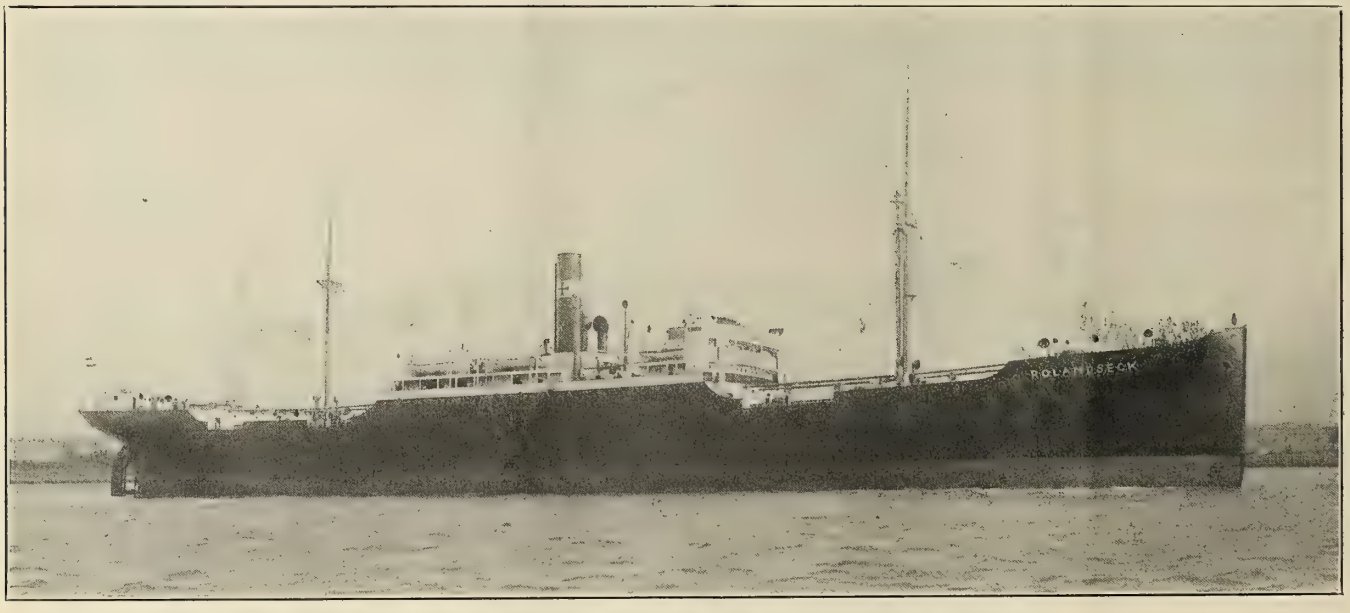


FIG. 1.—MOTOR-SHIP ROLANDSECK, EQUIPPED WITH TECKLENBORG-CARELS DIESEL ENGINE

It was in May, 1911, that we first described and illustrated a Carels type marine Diesel engine of 1,000 horsepower. Since that time considerable alterations have been made to the design of the Carels motor. Licenses have been granted by the designers to about half a dozen important engineering concerns, including Messrs. Joh. C. Tecklenborg, of Bremerhaven, Germany, who have recently built a general cargo and passenger carrying motor-driven ship of 2,700 tons deadweight capacity for the Hansa Line of Bremen. This vessel is fitted with a six-cylinder Diesel engine of 1,500 brake horsepower mainly built by the firm, the valves and other delicate parts having been constructed in Messrs. Carels works at Ghent, Belgium.

The *Rolandseck*, as she has been named, has now successfully completed her trials, and no doubt will be engaged in trading between Portugal and Germany by the time this appears in print. She is 290 feet long, 275 feet between perpendiculars, with 40 feet beam, and a molded depth of 27½ feet. On a draft of 18 feet 5 inches she will carry 2,700 tons, the holds having 175,000 cubic feet capacity. She is a single screw boat. Therefore her engine is at present the highest powered in service, although the eight-cylinder engines of the *Selandia*, *Jutlandia* and *Christian X* total 2,500 brake horsepower per boat. But as each cylinder of the *Rolandseck's* engine develops 250 brake horsepower, compared with the 156 brake horsepower of the *Selandia* and her sisters, the advancement is very noteworthy. Her speed is about 10½ knots.

Her engine is of the directly reversible, single-acting class, and each of the cylinders has a bore of 20 inches, by 36¼ inches stroke. They are arranged in pairs, mounted on heavy frames, upon a box bedplate, which is constructed in three sections. Accessibility is, of course, the great advantage of the "open" class of engine, otherwise there are no special features to claim for it, except, perhaps, that it produces a motor greatly resembling the modern marine steam engine. It will be noticed that a railed-off gangway has been arranged between cylinders four and five of this engine, so that the engineers can walk through with perfect safety when the engine is running. The power is developed at 120 revolutions per minute, the indicated horsepower being well over 2,000. The mean effective pressure is about 108 pounds per square inch. Residual oil of 10,000 calories per kilogramme is used as fuel, the consumption being less than .5 pound per brake horsepower per hour, which is not at all bad for a two stroke engine. The most economical four stroke oil engine has a consumption of .43 pound.

Compressed air for fuel injection and maneuvering—i. e., starting and reversing—is obtained from a Reavell compressor, which is driven off the crankshaft at the forward end. There are three double-acting scavenging pumps mounted on the port side of the engine and operated by means of rocking levers from the connecting rods of numbers 2, 4, and 5 pis-

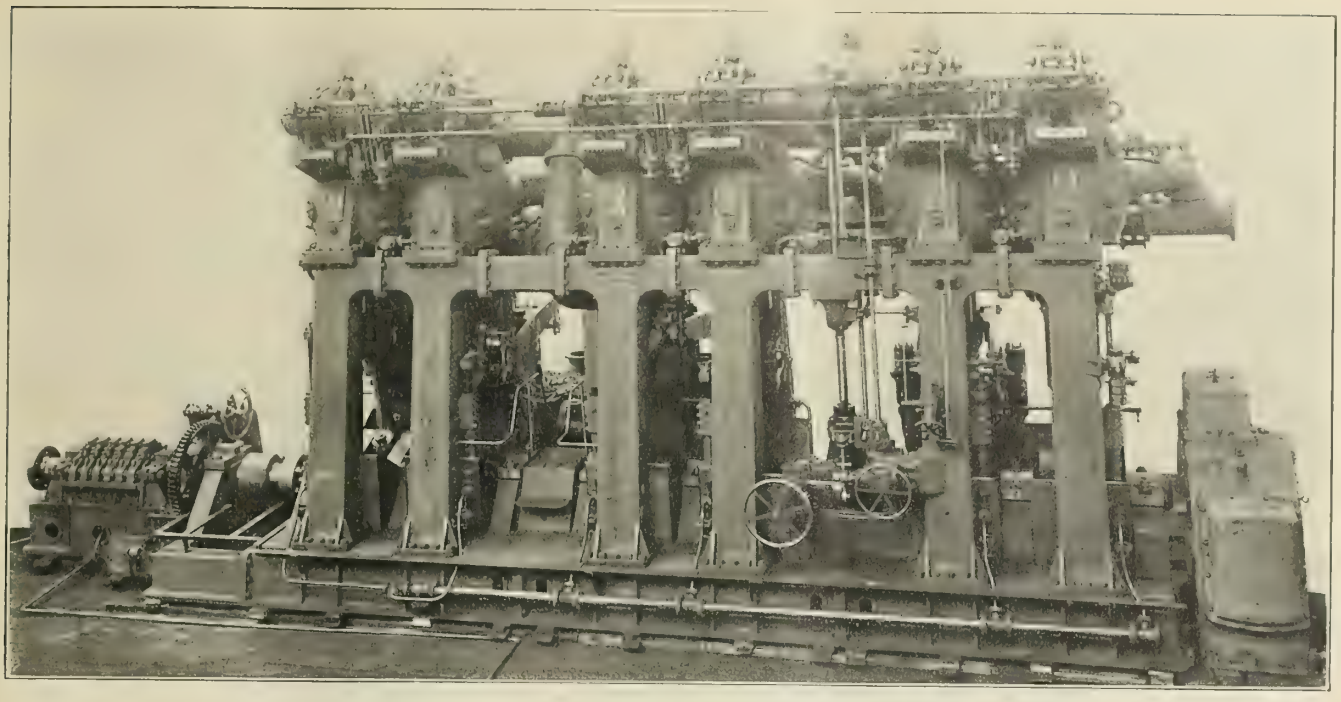


FIG. 2.—SIX-CYLINDER, 1,500-HORSEPOWER TECKLENBORG-CARELS ENGINE

tons. Automatic valves are fitted to the scavenging pumps. The air-starting, fuel-injection, and scavenging valves are all arranged in the cylinder head, and are operated by rockers off a camshaft running horizontally on the starboard side, the camshaft being actuated by a vertical shaft between cylinders 2 and 3.

Altogether there are six valves to each cylinder, but, it will be noticed, only four main rockers. Counting from the forward end of each cylinder, No. 1 rocker works two scavenging valves, which is carried out by the end of this rocker being extended and so operates another rocker. Next come the rockers actuating the fuel injection and starting valves, while No. 4 rocker operates two more scavenging valves in the same manner as No. 1 rocker. Thus it will be seen that there

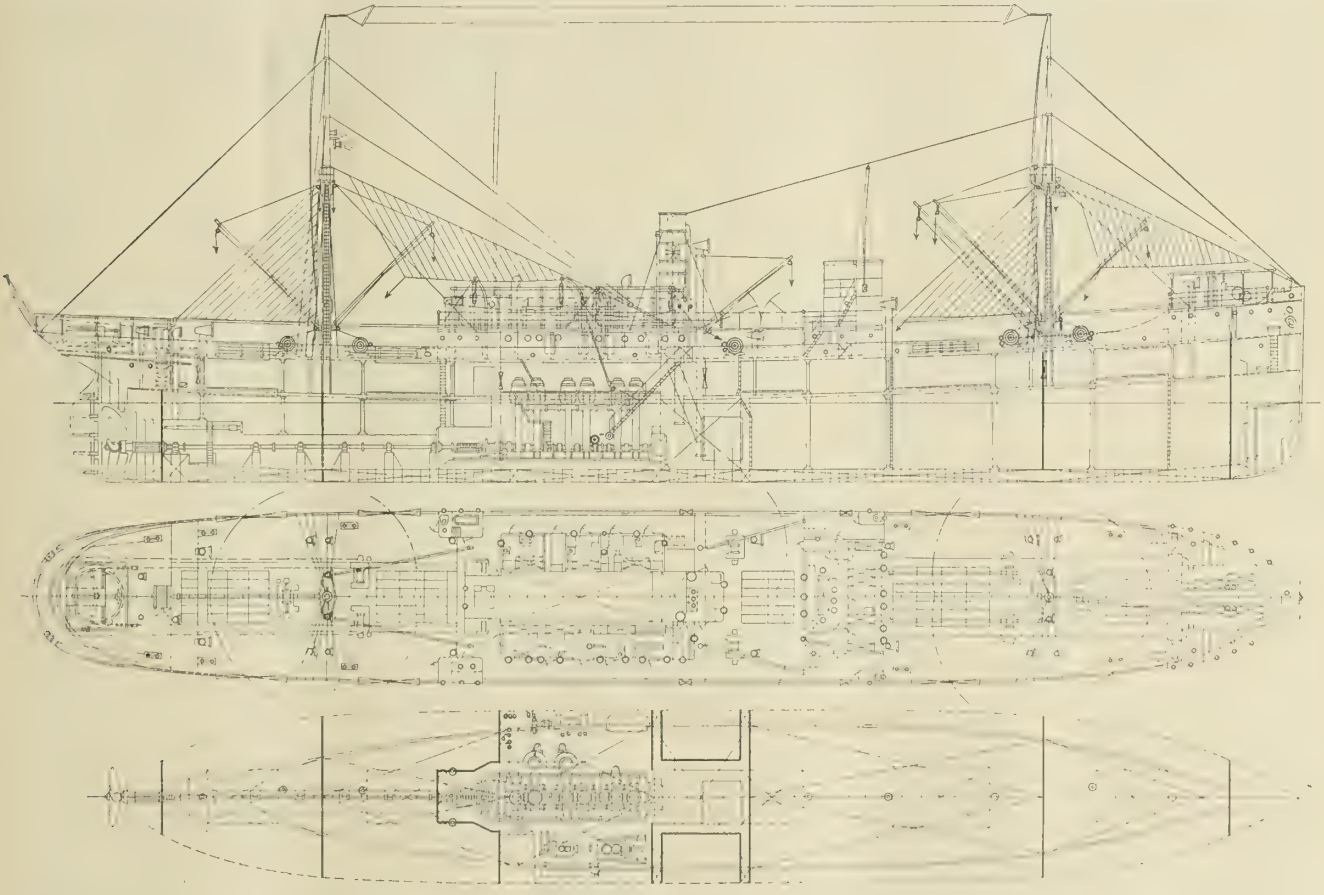


FIG. 3.—PROFILE AND DECK PLANS OF THE ROLANDSECK

are no fewer than four scavenging valves per cylinder. There does not seem any particular reason for such a large number, unless it is to avoid the excessive diameter fore and aft of larger valves. There is a great tendency among marine Diesel engineers to scavenge the combustion chambers by means of ports, with perhaps one valve in the cylinder head for ensuring efficiency. With the Junkers engine scavenging is carried out entirely by means of ports in the cylinder walls, which are uncovered as the opposed pistons are at points farthest away from each other. With *Rolandseck's* engine the fuel injection valve is also indirectly worked by its rocker, and an arrangement is fitted by which the secondary lever can be lifted clear of the valve stem, when starting or running on compressed air from the reservoirs. The latter are always kept fully charged, by means of an automatic maneuvering valve on the compressor. This obviates the constant attention of the engineer to the reservoirs, and the result would be serious if the reservoirs happened to have been allowed to run down just when an order for full speed astern had been signaled from the bridge.

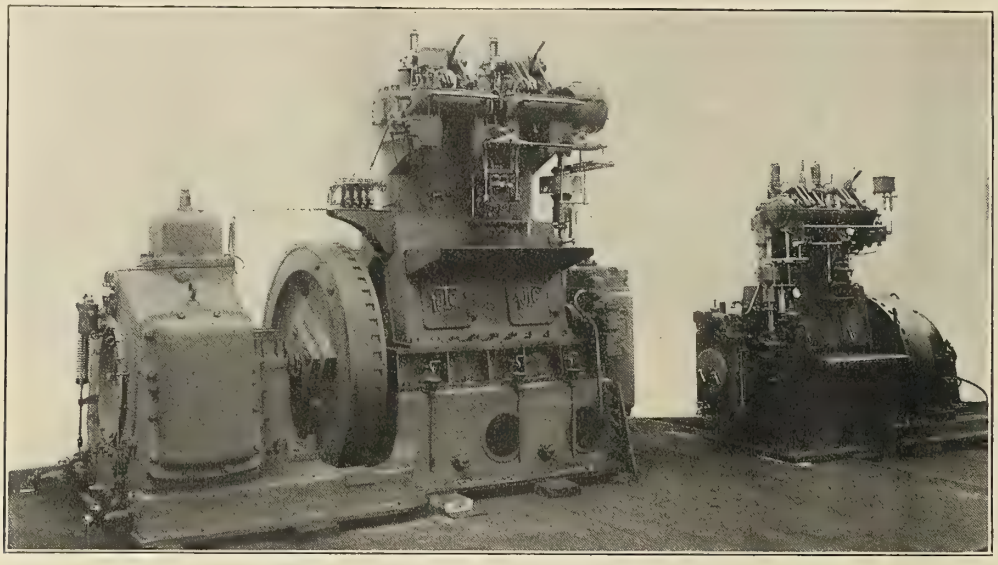


FIG. 4.—MOTOR-DRIVEN AIR COMPRESSOR AND GENERATOR FOR THE ROLANDSECK

Reversing is carried out by shutting off the fuel, and by means of compressed air or by hand the camshaft is turned to an angle relative to the crankshaft. The air starting valve is then opened in the cylinder, the piston of which is nearly at its highest point and the crankshaft rotated in the opposite direction. Fuel is then automatically turned on and the engine immediately picks up the load and continues running astern until re-reversed. There is, by the way, a separate fuel pump to each cylinder, the suction valves being controlled by the engine governor. The horizontal control rod from the latter can be seen below the cam and maneuvering shafts. This control rod is also operated by means of a hand lever.

If one may judge from the few two stroke engined ocean-going ships built, engine room auxiliary machinery will be of the four stroke type. *Monte Penedo's* main engines are two stroke Diesels, but her auxiliary motors are of the four stroke class, and the same can be said of the *Rolandseck*. She has two auxiliary compressors, one oil-fired steam driven, and another worked by a two-cylinder four stroke 100 horsepower Diesel motor of the enclosed type. The other auxiliary illustrated, it will be noticed, is coupled to a dynamo generating 110 volts at 160 amperes at 300 revolutions per minute, the driving unit being of 30 brake horsepower. This is used for the lighting of the ship and for feeding a motor, which turns a ballast pump of 100 tons capacity. An auxiliary boiler, oil fired, is installed for the windlasses, steering gear and heating of the vessel. There is also some minor auxiliary machinery. The total weight of all the propelling machinery and auxiliaries is in the neighborhood of 150 tons, and the bunker space gained allows of considerable extra cargo being carried. The donkey boiler is arranged at the forward end of the engine room, while on either side is a fuel tank, the two having a combined capacity of over 150 tons. The *Rolandseck* has been provided with a funnel amidships, to which the exhausts and the flue from the donkey boiler have been carried, so there is nothing in her outward appearance to distinguish her from an ordinary cargo steamer.

Fuel Oils for Use in Marine Diesel Engines

It has been proved definitely, not only by very rigid tests made for this specific purpose, but also by the actual operation for a reasonable period of time of Diesel engines in service, that oils suitable for use in Diesel engines may be said to cover a very wide range of contents. It is evident that out of the many different kinds of oil available, some will be found to be successful in certain types of Diesel engines, while others will fail to give satisfaction, and as it is not always possible to obtain the best kind of oil at every port where the ship may touch, some limitations must be fixed or trouble will ensue from the selection of the oil.

The subject should really be treated from two viewpoints. First, the grades of oil that can be successfully used in the Diesel engine, and, second, the source of supply available for ships in service. A recent continuous test was made by one of the large Diesel engine builders on oil having the following analysis:

Specific gravity, .947; flash point, 180; fire test, 226; viscosity, 237; water, 2 percent; sulphur, 3.6 percent; asphalt, 20 percent; B. t. u.'s per pound, 18,000.

The results of this test showed that from half to full load successful operation and complete combustion is easily attained, but while the engine is running light or with no load there is incomplete combustion and a resultant effect of precipitation of unburned oil on the piston and cylinder walls. This is not, however, a sufficient reason to reject the use of this oil, as it would only necessitate that the pistons be taken out and cleaned at least four times a year. With the higher percentage of asphalt there is also some accumulation of soot in the exhaust pipe, which, however, can readily be taken off. The frequency of cleaning the pistons in the exhaust pipe will, therefore, be dependent upon the load conditions under which the engine operates. Where oils having a high percentage of asphalt are used under conditions that would subject this oil to low tem-

peratures, it would be necessary to provide an auxiliary to heat the oil, so that it will pass through the small feed pipes to the pumps of the engine cylinders.

In considering the adoption in marine engines of oil corresponding to the above analysis, it should be noted that the engines should be of the two-cycle type which are not provided with exhaust valves, as it is the exhaust valves which suffer the most from bad fuel and from high temperatures, which are the result of poor combustion. This oil would offer no difficulties for use in marine engines when a ship is at sea and running at a normal load, but under the conditions arising when the ship is entering or leaving port, so that very low load is required from the engine, it would be advisable when using a very heavy oil with a high percentage of asphalt to have on hand a small supply of a more volatile oil for use in starting the engine.

The types of engines should be considered in relation to the grades of oils that can be used, and especial care should be taken to see that the atomizers of the engines are of such an accessible type that they can be taken apart readily and cleaned or adjusted for oils of different consistencies. On the whole, it would seem advisable to have a fuel pump supplied for each working cylinder, so that with the proper connections and valves the supply of oil may be changed from the cheaper heavy grade to the light or gas oil.

From the second viewpoint the Mexican oil fields can be said to have only just begun to show their possibilities. In 1911 there were only about 800,000 barrels of oil shipped from the Mexican fields, while in 1912 there have been approximately 6,000,000 barrels of crude oil shipped from Mexico, and yet the field has hardly begun to be developed. When the records show that there are wells flowing from 18,000 to 30,000 barrels per day, it can readily be seen that this field can be depended upon for a great volume of oil. The California oil fields, on the other hand, while developed to a great extent, show a production of something over 87,000,000 barrels of oil in 1912, with a large number of wells capped and not permitted to flow. It would seem possible to expect 100,000,000 or more barrels of oil available from this field per year. With these two great sources of oil, one available on the east coast and the other on the west coast, and with the completion of the Panama Canal near at hand, American merchant ships can at least feel assured of a dependable supply of oil being available for marine service. A factor that enters into this question of the supply of fuel oil which is of great interest to the shipowner is that, with the low fuel consumption of the Diesel engine for any given service, it is possible to take on a cargo of fuel oil for a very long passage without touching at any port for an additional supply. At least two instances proving the value of this can be found in the East Asiatic Company's ships, plying from Northern Europe to India, taking on fuel cargo for the entire voyage in India at a point where it can be bought at the lowest price, and in the case of the *Fram*, which, under the command of Captain Amundsen, made the record trip in his South Polar explorations without suffering any difficulties from the lack of fuel.

In conclusion, it might be said that if Diesel engines are being built for marine service of such types and with proved reliability they can be applied to the merchant marine service with great benefits accumulating in favor of their use in addition to their low fuel consumption, they certainly deserve serious consideration by shipowners, for by this low fuel consumption there is offered a means for aiding in the conservation of the supply of oil now available or that may be available in the future.

NEW RAILWAY DRYDOCK INSTALLED AT HARBOR GRACE, NEWFOUNDLAND

New Railway Drydock Plant

An interesting railway drydock plant, designed especially with the object of docking a large number of vessels during a short period of time, has recently been installed by the Crandall Engineering Company, East Boston, Mass., for the Marine Railway Docks Company, Harbor Grace, Newfoundland.

The plant consists of two railway drydocks placed side by side at a distance of 42 feet between their centers. The larger one is 600 tons deadweight capacity, the cradle of which is divided into two parts. The forward is 70 feet long and the aft 90 feet long over the keel blocks, with a width of 38 feet over the deck logs. The keel blocks are placed 6 feet centers

and the bilge blocks 12 feet apart. On the upper cradle are placed four sliding bilge blocks on each side and on the lower six, all being operated by chains and winches from the docking platforms.

The smaller drydock comprises two separate cradles traveling on the same set of tracks. The forward cradle is 60 feet and the aft 80 feet in length over the keel blocks, with a width of 34 feet over the deck logs. The capacities are 300 tons and 250 tons deadweight respectively. The keel blocks are 6 feet centers, and there are four bilge blocks each side for the upper and five for the lower cradle, operated in a similar manner to the larger one. All cradles are fully decked, and when hauled high and dry above the water, the height of deck from the water is 2 feet.

By this method of dividing the cradles, they may be so arranged that each one may be operated as a unit or independently. When operated independently four vessels may be hauled at one time, but they must necessarily be of lighter weight than could be hauled if the cradles of each dock were connected together.

The general dimensions are as follows:

	No. 1	No. 2
Capacity deadweight	600 tons	550 tons
Length over keel blocks	160 feet	140 feet
Length over each cradle	70 & 90 feet	60 & 80 feet
Draft of water over keel blocks at mean high water	10 & 15 feet	9 & 15 feet

The time of hauling a vessel fully up is about fifteen minutes in each case.

There are two sets of hoisting machines which are worked by one 8½-inch by 10-inch double engine. They are so arranged that each can be operated independently of the other. The hauling chains are of the long link type and made especially for this class of work and under the stiffest of chain specifications. The sprocket wheel is cast steel and the gears are all machine molded. The machine foundations and the struts from foundations to the head of the track are built of concrete reinforced. The track is of timber with pile foundation. Protection against the teredo is provided for by a thorough sheathing with creosoted planks placed over ship's felt and securely fastened to the track.

Marine Engineers' Convention.—The thirty-eighth annual meeting of the National Marine Engineers' Beneficial Association was convened at the New Charleston Hotel, Charleston, S. C., Jan. 20. The former officers of the association were re-elected for the ensuing year. William F. Yates, of New York, is president, and George H. Grubb, of Chicago, is secretary. The next annual meeting will be held at Washington, D. C., in January, 1914.

New Russian Submarine

BY F. C. COLEMAN

The Russian naval authorities have, during recent years, experimented with almost every design of submarine, with probably the single exception of the French boats. Considerable use has been made of the German-built boats, and, so far as speed requirements are concerned, the Bubnoffs and Beklemischeffs head the list, a speed of 15 knots under water being claimed for this design of intermediate-sized submarines.

The latest addition is a flotilla of three diving boats—*Karp, Kambala and Karas*—built at Fried. Krupp's Germania yard, Kiel. The first Germania boat built for the Russian navy was a 17-ton vessel, the experimental boat, *Forelj*, which saw some war service with the submarines which followed her in the Far East seas—the *Som, Delfin, Kasatka, Nalim, Skat, Osetr* and *Scheremetief*. The above-named submarines gathered during the war at Vladivostock, and those which arrived near its end—*Bishop, Paltus, Ploto* and *Shuka*—might have proved a better weapon if bad luck and want of organization had not frustrated the efforts of the officers in charge of them.

RUSSIAN SUBMARINE KARAS ON A SURFACE RUN

But some of the boats gave some trouble—the *Delfin* was damaged by an explosion and the *Nalim* sunk. The experience gained with the *Forelj* may be said to be partly responsible for the order of three Germania diving boats, embodying on a larger scale the same principles experimented with in time of actual war with their small predecessor.

The general appearance of the new Russian submersibles is shown by the accompanying illustration, which represents the *Karas* at a full-speed run on the surface. One of the cardinal virtues aimed at in the design has been seaworthiness, and besides this great stability and radius of action and quick diving are claimed for these Germania boats. The dimensions of *Karas* and her sister ships are:

Length, overall, 131 feet; breadth, 10 feet; draft, surface, 8 feet 2 inches; surface displacement, about 196 tons; submerged displacement, about 236 tons; armament, one 18-inch torpedo tube and three torpedoes; surface speed, 11 knots; submerged speed, 9 knots.

Propulsion by means of electromotors when submerged, and by petroleum motors on the surface. The Germania boats burn ordinary petroleum, a fact which practically eliminates all danger of explosion. Another source of danger is minimized by the disposition of the fuel tanks outside of the ship's hull.

These boats, after having undergone their official trials, were manned by Russian crews and performed a series of interesting trials in the bays of Kiel and Eckernförde. At the conclusion of these experiments they left Kiel for Libau, and reached that port in about 50 hours, thus averaging 8.33 knots

flotilla speed. This performance, though it does not break the "UI" record—Kiel-Heligoland, 600 miles—as far is seagoing speed is concerned, is of particular interest, as the speed attained is of a tactical group of three units.

Port Facilities for Ships and Cargoes*

BY WILLIAM T. DONNELLY

Port facilities for ships and cargoes form the most important link in the world's transportation, which, broadly speaking, is perhaps the most important activity which engages man's attention. Port facilities embrace the harbor, piers, railroads, floating harbor equipment and all the minor appliances, such as storage, rehandling and transfer facilities. When we look for the most important factor or controlling feature in the problem, we find it to be the ships by which the transportation is effected. The vital principle and earning power in transportation is the movement of vessels and cargoes from one place to another.

The fundamental difference between European and American ports is that nearly all of the great ports of European countries are a considerable distance from the sea, while most of the ports in the United States and Canada are on the seacoast. This brings about an entirely different situation relative to the port facilities. Therefore, it is not practicable to compare the port of Hamburg with the port of New York, and the methods and devices used in the one city are not at all adaptable to the other.

Another fundamental difference is the fact that, while the port of New York is by far the largest of any in the world, it is not the home port of any of the great transatlantic steamship lines, and it is very plain that a company owning ships will make greater investments for port facilities at a home port than at a foreign one.

Perhaps the greatest difference between the port of New York and any of the foreign ports is the extent to which lighterage is used in this port. Manhattan Island is reached direct for freight purposes by only two of the many railroads that reach the harbor front, and access to and from Manhattan Island, Long Island, Staten Island and the adjacent waters is brought about by a very extensive system of harbor transportation known as lighterage, by which all kinds of both rail and water transportation is moved to and fro at a minimum cost and with the greatest flexibility.

A part of this transportation is the system of car floats or the handling of railroad freight cars upon floats or barges built and used for that purpose only. These car floats were originally designed solely for ferrying purposes, but it was soon discovered that they formed one of the most flexible devices for freight handling in and about a large marine terminal, and they must now be considered one of the most important features of the port of New York. In fact, so valuable are they to the railroads that piers devoted exclusively to the loading and unloading of cars on floats have been taken over one after the other along the lower part of Manhattan, until at the present time this diversion of the piers to railroad business sorely vexes our dock commissioner.

When the American piers are considered relative to the piers of foreign ports, the principal difference is the absence of heavy lifting machinery, which is always a very prominent feature of the foreign ports. This has been brought about by the adaptation of floating derricks for handling all heavy weights from lighters to ship's hold and from ships to lighters, and then to the pier head and bulkhead for rail transportation or delivery in the city. The development of this particular branch of our transportation is an American feature and owes the extent of its development very much to apparatus primarily designed and developed for wrecking purposes.

In the practice of this port, only the lighter portion of the cargoes are handled over the ship's side on to the piers—that is, objects weighing a maximum of two tons, such as are readily handled by ship's winches and similar winches on the pier. A fixed or traveling crane located on a pier can serve but one ship, and often not more than a single hatch of that ship, while a floating derrick or lighter may move from ship to ship and from one part of the harbor to another and find very much more constant occupation.

A great deal of consideration has been given to the matter of bringing the railroad and steamship close together, but wherever this has been tried out it has not been found to be practicable. Many piers are built with railroad tracks running down the center, but very few cars will be found at any time on the piers. This is largely owing to the fact that a freight car is a very awkward object to move about, and that it contains a comparatively small quantity of goods; also, that the shifting and moving of the freight cars interfere very much with the work of handling material on the pier. Of course, this does not apply to goods that can be delivered in carload lots, such as grain, coal and ores, for such materials do not come to the steamship piers referred to, but to special piers devoted entirely to their reception, where they are handled by machinery at as low a cost in this country as anywhere else in the world.

The coaling of ships in this port is of a somewhat unusual character, and to a certain extent affects the methods of freight transwer. Coal is brought to the ship's side in canal boats containing from 400 to 600 tons. To expedite the coaling it is done on both sides of the ship—that is, first on the offshore side and then the ship is breasted out or moved some 20 feet or 25 feet from the pier, the coal boat moved in between the pier and the vessel, and the bunkers filled on that side.

It is apparent that cranes fixed on the pier during this time would have to extend or over-reach some 25 feet further, while the ship's winches, working in connection with a similar winch on shore, can transfer freight without interruption. These winches are designed to handle from one to two tons on a single line, and to be operated by the ship's crew and with whatever assistance is necessary from the shore. Small packages are aggregated in the familiar rope netting and form packages, such as boxes and barrels, are readily handled in the aggregate in slings.

From an extended familiarity with this work, it would seem that there is little probability of any other mechanical appliances superseding this method in this port, when freight is to be hoisted from a ship's hold. When freight can be delivered from a gangway at or below the pier level, mechanical devices to assist stevedores with hand trucks on grades have been found practical, and these devices are also much used to and from lighters which bring a considerable amount of material to the piers for storage and transshipment to vessels.

Ordinary freight elevators, inclined elevators and slideways are used to move material from one level of a pier to another, and various overhead telpherage systems are used for handling and tiering, but these mechanical devices must be carefully

* Abstract of a paper read before the American Society of Mechanical Engineers, New York, February, 1913.

studied to meet known and special conditions, and very serious mistakes can and have been made by only a one-sided understanding of the situation.

Any device which will assist a longshoreman in his work with the familiar two-wheel truck can find a place, but any device which would tend to replace or eliminate him from the package freight handling problem must be looked at with very great care and some distrust.

The coaling of ships from canal boats in this port is a slow and tedious process, requiring from ten to fourteen men in a boat shoveling coal into tubs, and an equal or greater number in the bunkers distributing the coal, the rate of loading being approximately 25 or 30 tons per hour, which is strictly limited by the rate of trimming the coal inside the ship. A number of attempts have been made to replace the cost of this work by a more extended application of mechanical means, and some progress has been made, but the fact that the coaling of the boats is, as far as possible, made a secondary consideration to the handling of freight, and must often be interrupted, has been a stumbling block to any decided advance in this direction.

No discussion of port facilities would be at all complete without some consideration being given to the matter of facilities for getting the freight to and from the steamship piers; that is, should the railroads deliver the material in cars on piers or to the terminal adjacent thereto, and to what extent and how should the railroads and waterfront be tied up together?

New York, which, of course, is by far the largest commercial port in America, and, for that matter, in the world, has examples of both the worst and best arrangement of marine and rail transportation. The Atlantic freight and passenger transportation commenced to and from the port of New York, and has found its continued and greatest development in connection with the west side of Manhattan Island, and it is over this waterfront, as the business developed, that it has been necessary to transfer between ship and railroad and ship and factory vast quantities of merchandise.

Owing to the fact of its isolation, this waterfront was reached by but a single railroad—the New York Central—and this remarkable condition continues up to the present time, and has been very much aggravated by the fact that it was necessary to connect this shore front with the terminals of other railroads across the Hudson by a great many passenger ferries, and the history of the west side waterfront of New York is that of a contest between the rail transportation interests to keep a railroad right-of-way along the waterfront and the people of New York to have it removed on account of danger to life and limb.

In the meantime, the Atlantic transportation business has steadily grown and congestion along the waterfront has been steadily increasing. To meet this, the railroads terminating in Jersey City have adopted the practice of leasing the piers along the lower Manhattan waterfront and using them for the receipt and delivery of railroad freight, which, of course, results in the exclusion of transatlantic and coastwise commerce from these piers. This condition is quite satisfactory to the railroads, but is looked upon with very great disfavor by the steamship lines and also by the Dock Department, which has at heart the best interest and most desirable use of the waterfront for marine transportation. It also results in a very great congestion of the piers and West Street from trucks bringing and removing freight.

An independent study by private parties of these conditions some time ago resulted in the most remarkable industrial development that any city has ever seen. I refer to the Bush Terminal in South Brooklyn. The Bush Terminal Company made a study to bring about in connection with the waterfront a condition similar to that prevailing outside of New York City; that is, they provided on the waterfront float bridges where not only one, but all the railroads could deliver freight cars to shore tracks, and a car distributing yard on their own property, from which the cars could be delivered as required alongside factory buildings, so as entirely to eliminate trucking charges and, what was still more important, unnecessary delays and confusion in shipping.

The company also created a system of piers backed up by storage warehouses for the receipt and storage of raw material between producer and factory, and also for the storage of finished material to be accumulated for shipments abroad. The result is that we have on the South Brooklyn waterfront the most perfect system of rail and marine freight handling, manufacturing and redistribution that has been accomplished to date anywhere in the world. All confusion and interference has been eliminated and congestion is unknown, and the general plan is being studied and copied in many parts of the United States.

Broadly speaking, there is no difference from an engineering point of view between the South Brooklyn and Manhattan waterfronts. The same arrangement applied to the Manhattan waterfront would bring about just as satisfactory a solution of the problem. The only added complication is the fact that great numbers of people must have access to the Manhattan waterfront, and it has been the contention that their safety is of the first importance, and that consequently no additional railroad facilities should be allowed upon that waterfront, and even those existing should be removed, and to this end the Dock Commissioner has prepared an elaborate plan for removing the railroad tracks from the surface to an elevated structure, this structure to be extended along the waterfront and to be accessible to all railroads. To my mind, there seems to be an almost insurmountable difficulty to this plan; that is, the grade to be overcome in raising the cars from the water level to from 25 feet to 30 feet above, and the additional very great expense of supporting freight cars and locomotives upon an elevated structure. Primarily, it would seem that the object to be attained is the separation of the passenger and freight transportation, and it would appear that this could be brought about at very much less expense by elevating the passenger traffic at and along the waterfront; that is, treat the Manhattan waterfront in exactly the same manner as the Brooklyn waterfront, and then, for the passenger traffic which must be provided for, create an elevated street or highway adjacent to and along the front of the piers on West street, this elevated street to be used exclusively for foot passengers and vehicles for passenger transportation, to be reached at various points, which might be every third or fourth block, by ramps of such a grade as to be unobjectionable to foot passengers and vehicles, but very much greater than could be used for rail transportation.

It would then be possible to give all the railroads free access with cars to West street and eliminate all danger to foot passengers. The railroad and terminal companies would then take and develop the property on West street, now of comparatively little value, in a similar manner to that in South Brooklyn, and the cars would be run from West street directly into these terminals for loading, and the car floats would disappear from the waterfront except at the float bridges.

The one precaution that should be taken would be not to allow cars on any streets extending back from the waterfront; that is, to force all rail connections to terminals through private property and reserve the street exclusively for ordinary traffic. The practicability of foot passengers going over, rather than across, West street at grade has been shown by the private footways at the foot of Liberty and Cortlandt streets, and it is a well-known fact that nearly all access to and from passenger steamers is from the upper decks of piers. The elevated highway along West street would not only re-

move the foot passengers from the wet and dirt inseparable from the waterfront, but would provide a very much needed highway north and south exclusively for passenger traffic. It is hardly necessary to point out to engineers the very great saving in the cost of such a structure over one necessary to carry and distribute freight cars.

The foregoing is not offered as a criticism of the elaborate terminal plans so thoroughly worked out by the Dock Department, but as a suggested modification which would make the plan as a whole more possible of execution by avoiding the three percent railroad ramp or grade on West street, with a sharp curve at the foot.

By this modification it would also be possible to distribute the car-float bridges along the waterfront, which it is believed will be much more practical than to have them all at one point. It might be added that there is ample room on West street for the present street car tracks next the West street sidewalk, then four railroad tracks, and beyond a sufficient width of street surface to allow for ready access of trucks to the piers.

Marine Turbine Operation and Economy *

BY LIEUTENANT-COMMANDER H. C. DINGER, U. S. N.

Points in Securing Economy

Dry Steam.—It is evident that moisture in the steam has a bad effect on the economy of the turbine. It is therefore essential that the design and management of the boiler plant be such that dry or slightly superheated steam is furnished. The use of steam domes on the boiler of torpedo vessels appears to be desirable. Water tenders should be trained to carry continually a uniform and safe water level and to guard against carrying a high or fluctuating one. The use of superheated steam would appear advisable in cases when the blading will permit its use.

Vacuum.—Economy is largely dependent upon the vacuum. Every turbine installation should have a vacuum augmentor or some form of dry air pump whereby a vacuum within one inch of the barometer can be maintained with circulation water at 70 degrees F. Experience has demonstrated the augmentor to be generally more reliable and simpler to handle than the dry vacuum pumps. Even with a proper condensing apparatus and air pump, the vacuum may be adversely affected by the following:

1. Leakage of air through turbine glands. The turbine glands are usually packed with auxiliary exhaust steam or other steam of reduced pressure, and care must be taken to see that a pressure above the atmosphere is carried on the glands at all times. For this reason the pressure gage on the gland system must be frequently tested for accuracy. One or two pounds pressure on the glands is sufficient, but you must be sure of having this pressure. When cruising turbines are cut out, but shafts not disconnected, special care must be taken to see that proper steam pressure is on the glands, because under these conditions the cruising turbine is running in vacuum and the opportunity for air leakage is much greater. Care must also be taken to see that the leak-off to the condenser is open only when necessary. With the leak-off open to the condenser, the whole system is bled of steam and ordinarily the leak-off to the condenser can be closed.

2. Air leaks in piping and exhaust connections. These leaks may be anywhere in the ship and the most careful watch must be kept on them. A small drain connection left open may reduce the vacuum by a half inch or more. It is preferable to run all drains, exclusive of turbine drains, to feed heaters, feed tanks or auxiliary condenser, so as to avoid any possible air leaks into the main condensers.

3. Condenser air bound on water side. This may be remedied by providing an air cock near the top of the water space and keeping it slightly open.

4. Tension on springs of air pump valves. Usually the tension on the springs of the foot valves of the air pumps is considerably more than is necessary to properly seat the valves. Slacking back on the valve springs will in many cases result in gaining a quarter to a half inch of vacuum.

5. Condenser tubes choking up. Condenser tubes from time to time choke up with seaweed or other matter drawn in with the water. When tubes are thus plugged they are rendered inoperative for condensing purposes. Regular and frequent examination will prevent any serious choking of tubes.

6. Exhaust joints not tight. The manner of making joints in exhaust lines is of great importance. The very greatest care should be exercised on the making of these joints. Painting the edges of joints with shellac has been found to be a serviceable method of stopping a small air leak.

Vacuum is almost everything in turbine economy, and it is often most difficult to get machinery attendants to realize it. Eternal vigilance is necessary. A small air leak, here or there, hard to locate, soon will mean tons of coal lost. A vacuum within an inch of the barometer can be maintained if all leaks are cut out, and anything short of this should not be accepted as satisfactory.

Dummy Clearances.—These must be constantly watched. If they become too great, there is a loss in economy. If too small the dummy rings will touch, parts may tear out and the turbine be wrecked.

The low-pressure dummies are arranged so as to have from twenty to thirty thousandths of an inch average clearance. This, with six to eight thousandths float, will give actual readings from fourteen to thirty-six thousandths, and in special cases limits outside of these will be obtained. This amount of clearance is necessary for safety. As the low-pressure shafts take propeller thrust and also have the reversing turbines and the largest rotor, it may be said that a reading below ten thousandths should never be allowed on a low-pressure and astern turbine.

On the high-pressure turbine the leakage will be relatively greater for the same clearance. The rotor is not as large, and hence a lower clearance may be permitted. If there is a reversing turbine on the same shaft the clearance should not be allowed to go below eight thousandths. If there is no reversing turbine the limit may be six thousandths.

The cruising turbines take no propeller thrust, and if the flexible coupling between the cruising and the main turbines can be depended upon a less clearance can be allowed. For cruising turbines, six thousandths should be the least clearance allowed.

The personal error of taking a reading of dummy clearance should not be over two thousandths, hence with six thousandths as the limit there is sure to be three or four thousandths clearance. It must, however, be absolutely known that at these minimum readings the rotor is actually in up against the thrust collars and the thrust adjusting ring; for if these low readings are obtained and the rotor can come in still further, a dangerous condition is presented.

If you are positive that the rotor is all the way in, and that the readings are accurate, clearances of one or two thous-

* Concluded from the February issue.

andths are all right. On the other hand, if you are not sure that the rotor is in, a clearance of ten thousandths may be dangerous.

For very large turbines somewhat larger clearances should be allowed. It is, however, believed that a larger average clearance than thirty thousandths on low-pressure, twenty-five on high-pressure and twenty on cruising turbines should not be permitted if good regard for economy is taken.

Lubricating System.—Perhaps the most important thing in connection with operating a turbine plant is the lubricating system, and efficient lubrication has an important bearing on turbine economy.

The oil must be kept absolutely clean and free from water. When oil is received, it should be strained through several thicknesses of muslin, or, better, through chamois skin. The entrance of salt water into the lubricating system must be carefully guarded against. Salt water can enter from a leak in the oil cooler or from using salt water on bearings. The use of salt water for cooling bearings should not be permitted, since once salt collects in a bearing, that bearing is very liable to be cut and scored.

Water and dirt will collect to some extent, even if the greatest care is taken, and when standing idle the water and dirt will gather in the lower part of the bearings. The water may cause a little rust to form which may cut the white metal, and the dirt will do the same. To guard against this the oil pump should be put on the lubricating system for a short time each day, so that the oil in the system is moved along and the water and dirt will not have such a good opportunity to collect.

In order to get rid of the water and dirt in the system, the bottom layer of oil in the drain tank should be drained off each day. This mixture of dirty oil and water may be filtered and used again, but it is not advisable to use such filtered oil except in auxiliaries. After every two months the oil drain tank should be completely cleaned out and the lower half of the oil filtered or treated. In order to cause the oil and water to separate, the oil in the tank should be heated. This can be done by putting a small steam coil in the drain tank. The dirt which collects in the oil consists of impurities in the oil, rust from the journals, small particles of metal worn off bearings or journals, and loose matter laying in the piping or other parts of the system. After a period of use the lower layers of oil in the lubricating oil tank will form into a more or less gummy mass. Straining and filtering the oil, heating and letting it stand, will remove this condition. It has been found that after a lot of oil has been in use for some time, its lubricating value is reduced, and that if this oil is allowed to settle and stand for a period of several weeks it will tend to regain its lubricating value.

With a good forced lubricating system, carefully looked after, very little oil is lost. That drained off from the bottom can be used for auxiliaries, so that the leakage is practically the only loss. A destroyer of 15,000 shaft horsepower has been known to run on an expenditure of less than 10 gallons a month, while steaming 3,000 or 4,000 miles during this time, and a battleship has run for three months, making 4,000 miles on an expenditure of 250 gallons. The pressure used on the forced lubrication system is an important matter, affecting oil expenditure. If a high-pressure is used leakage will, of course, be increased. With a properly designed system a pressure of 5 to 8 pounds in the discharge pipe from the cooler to the bearings should be sufficient.

Oil Cooler.—The design of the oil cooler should be such as will not introduce any considerable resistance, and thus necessitate carrying a high oil pressure at the pump. In some designs considerable resistance and consequent necessity for carrying a high-pressure at the oil pump is encountered.

Ring Oilers.—The practice of using ring oilers entirely separate from the forced lubrication system for all line shaft bearings is very satisfactory. This arrangement reduces the amount of piping and fittings in the system under oil pressure, and hence greatly reduces the leakage. The ring oilers have been found to be very satisfactory and give no trouble, only requiring occasional cleaning out and renewal of oil.

Methods of Observing Oil Temperatures.—A very important matter is the position of the thermometers on oil bearings. These should be in places where they can easily be read, for if it is difficult to get at them they will often not be looked at when they should. A very satisfactory arrangement is that employed on Parsons installations, built at the Bath Iron Works. The returns from the various bearings all lead to a manifold immediately above the oil drain tank. The manifold has a glass top through which the stream of oil from each bearing can be seen. A thermometer is placed at the end of each return pipe close to the manifold. One man standing in one position can thus observe the streams of oil and note the temperature. As soon as any bearing warms up it is noted immediately, because all the thermometers are under observation all the time. The matter of observing temperatures of bearings is thus greatly simplified. When carefully laid out the manifold system requires no more piping and fewer fittings than when a separate sight glass and thermometer is at each bearing.

Use of Auxiliary Exhaust.—The use of auxiliary exhaust in the turbines adds considerably to the economy. The exhaust should, of course, be used on the feed heater, but all excess that the feed heater cannot utilize should be used in the turbines. There are usually several connections, so that the auxiliary exhaust can be turned into different parts of the turbine installation. It is usual to have a connection to the intermediate turbine. This can be used at low cruising speed when the pressure in this turbine is below the pressure carried in the auxiliary exhaust pipe. Then there is usually a connection in the low-pressure turbine. This connection can be used at high powers. In some installations there are additional connections for admitting an exhaust into the third or fourth exhaust of the low-pressure turbine. This allows the exhaust to be used at still higher powers. At near full power the pressure in the turbines, at the connections, is sometimes above the pressures that can be carried in the exhaust pipe and under these conditions the excess auxiliary exhaust must be put into the condenser.

The auxiliary exhaust should always be used in that part of the turbine whose pressure is slightly below the pressure in the auxiliary exhaust line. Care must be taken that the pressure at that stage is below and not above the pressure in the auxiliary exhaust, for otherwise steam may be taken out at the turbine.

The question of whether it is better to use the auxiliary exhaust in the lower stages in the turbine or in a feed water heater is sometimes debated. Both theory and practice show that there can be no question but what it is more advisable to use this exhaust for feed heating, or rather use the amount necessary to heat the feed water to the highest temperature that the heat in the auxiliary exhaust will give. When using the auxiliary exhaust in the feed heater it is theoretically possible to abstract about 100 B. t. u. per pound of the steam. When used in the low-pressure turbine only about 25 B. t. u. per pound of steam can be extracted. With proper feed heaters very nearly theoretical results can be obtained. Now, of course, only the amount of steam required to heat the feed water up and the temperature obtainable with the pressure in the auxiliary exhaust should be used in the feed heater. Any more than this is simply wasted and should be used in the turbines. Therefore, the practice should be to use such of the exhaust as is needed to heat the feed, and use all the remainder in the turbines.

In order to get all the heat possible out of that used on the feed heater, the drain from the feed heater should have an efficient trap or water seal and drain to the feed tank. There should be an air connection to the steam side of the heater to keep air from collecting and the heater should be carefully watched to keep it from flooding.

The feed to the boilers should be as uniform as possible in order that the rate of flow through the heater may be uniform, and so that the maximum temperature of feed can be held at all times. This is a matter that may often be overlooked, but a uniform feed will probably give from 5 to 10 degrees higher average temperature of feed than an irregular feed will give.

Losses from Leaky Valves.—This is one of the principal fields for lack of economy. If any of the throttle valves or the non-return valves between the high-pressure cruising and intermediate-pressure cruising, or intermediate-pressure cruising and main high-pressure, are leaky, there is a loss. If all these valves are leaky the loss may be very considerable. The valves between the high-pressure cruising and intermediate-pressure cruising and the intermediate-pressure cruising and main high-pressure are often caused to become leaky due to hammering on their seats when warming up or in maneuvering and slowing down. It is also very important that the various drain valves and leak-offs be tight, since leakage through these is a direct loss to the condenser.

The valves which admit the auxiliary exhaust into different points of the turbines must also be tight. If these are leaky they may act as a bypass around the turbines, and possibly to the condenser.

The large throttle valves and non-return valves between the turbines when fitted with cone seats are practically impossible to keep tight, owing to the unequal expansion and consequent distortion of the seats when heated up. Therefore flat-seated valves and preferably flat flexible valve disks would appear to be better suited for this service. The degree of tightness of these valves has a most important bearing on the economy of the plant.

Use of Most Economical Combination.—In cruising at medium or low speeds it is important to operate the turbine combinations that will give the speed with the greatest possible economy, and the highest cruising combination should be used as long as it will give the power required. If near the limit of power of any combination, the bypass on the cruising turbine and the bypass on the throttle of the next lower combination should be opened. This will increase the power and still give greater economy than shifting to the next lower combination. Cracking the throttle valves of the lower combinations is not recommended, as it is liable to cause erosion of the valve and seat and thus bring about leakage.

Stand-by Losses.—Due to the necessity for having gland steam on and the large number of auxiliaries that have to be run, the stand-by losses with the turbine installation are considerably greater than is the case with reciprocating engines. Therefore the turbines and auxiliaries should not be kept in stand-by condition, ready to move, except when absolutely necessary. The turbines should not be made ready until a short time before they are required, and should be secured and their auxiliaries slowed down and secured as soon as possible after anchoring. Also maneuvering with turbines—that is, backing or calling for different speeds on the various shafts—is very wasteful, and if economy is desired such maneuvering is to be avoided as much as possible.

Summary of Points in Securing Economy

The following summary of points for securing economy may be given:

1. Highest boiler efficiency.
2. Dry steam and superheated steam where permissible.
3. Highest possible vacuum.
4. Reduction in dummy clearances to lowest limit for safe running.
5. Avoidance of leaky valves, such as throttle, bypass, gland steam and drain valves.
6. Use all excess auxiliary exhaust that cannot be used in feed heater in turbines.
7. Provide economical auxiliaries and operate them in as economical a manner as possible.
8. Maintain lubrication system in efficient condition.
9. Operate that combination of turbines which will be nearest to full power for speed required.
10. Avoid stand-by losses and maneuvering as much as possible.

By care and attention to all these points a very good economy can be obtained and even at very low powers results that approach close to those obtained by good reciprocating engines can be obtained. At low powers the steam used by the auxiliaries is the great factor. This must be reduced to the lowest limit possible, and all the auxiliary exhaust must be used to the very best advantage.

Use of Vapor for Evaporators in Low-Pressure Turbines.—An appreciable gain in economy may be realized by turning the vapor from evaporators (when distilling for make up feed) into the auxiliary exhaust line, and using this in the low-pressure turbines. In this way some of the heat which is otherwise lost in the distiller circulating water is made to do useful work in the turbine.

Use of Reheaters.—It is very likely that the employment of reheaters in the receiver pipes, between the high-pressure and low-pressure turbines, would result in an appreciable gain in economy. The steam for this purpose could be taken from the separator, or steam line drains, or from pockets on the lower side of the high-pressure casing, about half way down the casing. Taking the heating steam from these sources would serve to get rid of the moisture at the high-pressure end, and the heat in the moisture could still be utilized to dry the steam going to the low-pressure turbine.

Progress of U. S. Naval Vessels

The Bureau of Construction and Repair, Navy Department, reports the following percentage of completion of vessels for the United States Navy:

	Tons.	Knots.		Nov. 1.	Feb. 1.
BATTLESHIPS					
New York	28,000	21	Navy Yard, New York	62.5	69.6
Texas	28,000	21	Newport News Shipb'g Co.	79.2	84.3
Nevada	28,000	20½	Fore River Shipb'g Co.	10.1	19.6
Oklahoma	28,000	20½	New York Shipb'g Co.	9.3	14.9
TORPEDO BOAT DESTROYERS					
Henley	742	29½	Fore River Shipb'g Co.	96.9	100.0
Cassin	742	29½	Bath Iron Works.	60.4	77.5
Cummings	742	29½	Bath Iron Works.	52.7	68.5
Downes	742	29½	New York Shipb'g Co.	25.0	37.1
Duncan	742	29½	Fore River Shipb'g Co.	44.4	63.0
Aylwin	742	29½	Wm. Cramp & Sons.	61.3	83.5
Parker	742	20½	Wm. Cramp & Sons.	56.6	77.9
Benham	742	29½	Wm. Cramp & Sons.	56.0	72.4
Balch	742	29½	Wm. Cramp & Sons.	58.6	81.1
SUBMARINE TORPEDO BOATS					
F-4	....	....	Seattle Con. & D. D. Co.	94.6	94.6
G-4	....	....	Wm. Cramp & Sons.	88.3	88.3
G-2	....	....	Newport News Shipb'g Co.	86.0	86.0
H-1	....	....	Union Iron Works.	84.5	87.2
H-2	....	....	Union Iron Works.	84.5	86.7
H-3	....	....	Seattle Con. & D. D. Co.	82.1	84.9
G-3	....	....	Lake T. B. Co.	60.0	61.9
K-1	....	....	Fore River Shipb'g Co.	54.2	65.5
K-2	....	....	Fore River Shipb'g Co.	53.5	65.3
K-3	....	....	Union Iron Works.	59.0	68.1
K-4	....	....	Seattle Con. & D. D. Co.	54.5	66.1
K-5	....	....	Fore River Shipb'g Co.	38.6	48.5
K-6	....	....	Fore River Shipb'g Co.	38.1	48.5
K-7	....	....	Union Iron Works.	42.0	55.6
K-8	....	....	Union Iron Works.	41.5	54.1
COLLIERS					
Proteus	20,000	14	Newport News Shipb'g Co.	72.0	80.4
Nereus	20,000	14	Newport News Shipb'g Co.	62.5	72.1
Jason	20,000	14	Maryland Steel Co.	66.7	87.2
Jupiter	20,000	14	Navy Yard, Mare Island.	85.6	92.5

Recent Developments in Oil Fuel Burning*

BY E. H. PEABODY

Flat Spray Atomizers

Mention has already been made of the special advantages of this device, and the many forms of successful steam atomizers which give a flat flame warrant the belief that there is a wide field awaiting a thoroughly satisfactory flat spray mechanical atomizer.

I have referred to a flat flame atomizer formed of two flat surfaces pressed together, and another consisting of two

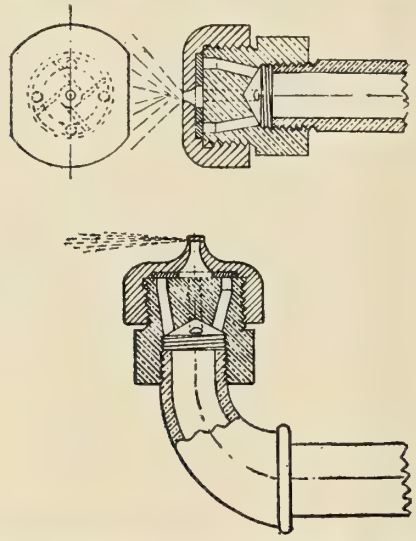


FIG. 16.—PEABODY FLAT SPRAY MECHANICAL ATOMIZER

round oil jets striking together. Neither of these schemes seemed to promise very much in the way of material for development. Another form which does seem to possess some merit, however, is illustrated in Fig. 16. This consists of a means for giving the oil a rapid whirling motion as in the case of the round flame burner and then releasing the liquid through a slot in the side of the tip in a plane at right angles with the axis of revolution instead of through an orifice concentric with the axis. It is apparent that centrifugal force will

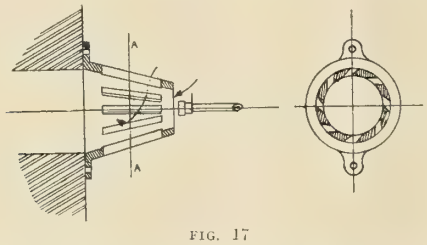
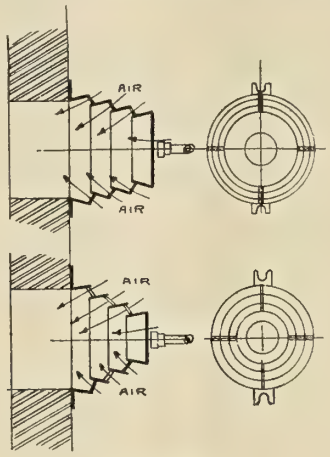


FIG. 17

here come into action as an atomizing agent, but that the spray will be flat instead of conical. So far as I know, the only flat flame mechanical atomizer which has been put on the market is that brought out by the Schutte-Koerting Company, and installed by them on the U. S. S. *Utah*. This burner is simplicity itself—a very considerable advantage—and the spray is excellent at low powers. About the only limitation which I have been able to discover in this burner is the fact that at anything over about 100 pounds of oil delivered per hour the spray loses its finely diffused character. The above installation was made under the direction of Mr. Luther D. Lovekin, a member of this society, whose various successes in burning oil fuel are too well known to require any mention here. I feel sure that if Mr. Lovekin would give his attention to this attractive little flat flame atomizer he would be able to make it a real factor in the art.

Air Distributors

While I have indicated some of the various air-distributing devices used in the experiments above described, it seems advisable to group these together with illustrations of some of the principal types which have been tried out. Great delicacy is required in introducing the air for combustion, very slight changes affecting the results in unsuspected ways, and while almost any method may result in smokeless combustion, maximum economy and capacity can only be secured by careful and intelligent design. It is not necessary to give the air a whirling motion, but, judging from our rather exhaustive experiments, better gas analyses are secured, lower air pressures are required, and less refinement of adjustment is



FIGS. 18 AND 19

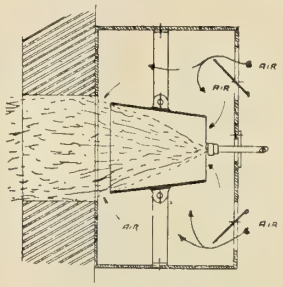


FIG. 20

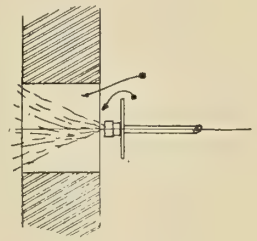


FIG. 21

needed if the air is brought into contact with the oil spray with the right sort of a twist. We have found the impeller plate illustrated in Fig. 12 most effective in accomplishing this mixture, and our most satisfactory results have been obtained with it.

We have, however, experimented with the following forms, some of which will be familiar to you:

Fig. 17. Cast iron truncated cone, with slots cored in the side so arranged as to give the air a whirling motion. It was tried with the end closed and all the air passing through the slots, and also with the end open, some of the air passing through the slots and some through the end of the cone around the burner. The burner was located at the end of

* Concluded from the February issue.

the cone as shown in the cut, and also pushed into the inner end of the cone, and also in intermediate positions. The whirling motion of the air obtained with this arrangement is of a different character from that obtained with the impeller plate.

Figs. 18 and 19. Truncated cones made up of concentric

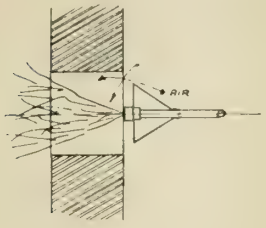


FIG. 22

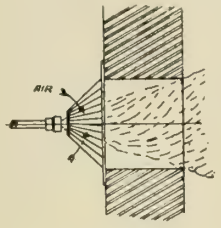


FIG. 23

rings of sheet iron, with air passages between them, and so formed as to direct the air toward the axis. The angle of the first set of rings was 7½ degrees, and that of the second set 15 degrees from the axis. No whirling motion.

Fig. 20. Truncated cone of sheet iron, no air openings in the side but air admitted at both ends, as shown by the arrows in the illustration. No whirling motion.

Fig. 21. Flat disk or plate of sheet iron placed on fire room side of burner tip to produce effect of directing the air to the

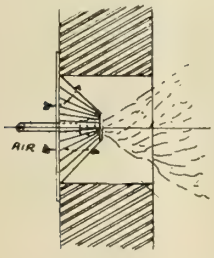


FIG. 24

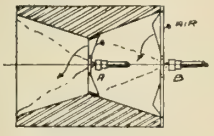


FIG. 25

oil spray, as shown by the arrows. Plate tried in various positions, also removed entirely. No whirling motion.

Fig. 22. Sheet iron cone placed over burner tip to direct air to spray as shown. Tried in various combinations with regard to burner tip and opening to furnace. No whirling motion.

Fig. 23. Conical bladed air impeller, air given a whirling motion and directed in toward axis.

Fig. 24. Conical bladed air impeller, air given a whirling motion but directed away from axis; reverse of last figure.

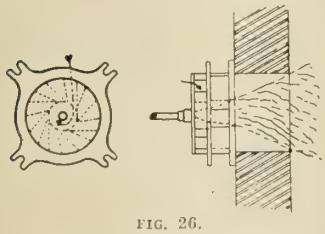


FIG. 26.

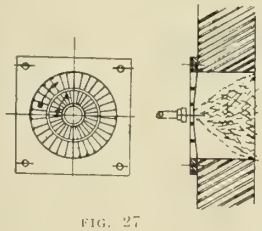


FIG. 27

Fig. 25. Venturi tube effect; air given a whirling motion by means of flat-bladed air impeller. Large impeller set at large diameter at entrance of tube, and also in another experiment small impeller set at contracted diameter of tube.

Fig. 26. Device for giving the air a whirling motion by delivering it in a plane at right angles to the axis of the burner, tangentially to an air chamber surrounding the burner tip. In this arrangement the air was given a whirling motion in a manner very similar to that by which the oil was given a whirling motion inside the burner.

Fig. 27. Flat-bladed air impeller giving the air a double twist, the outer blades driving it one way and the inner blades driving it the other. Also tried three sets of blades, the inner and outer sets driving the air in one direction and the middle set twisting it the other.

Fig. 28. Long horizontal slot admitting the air into a cham-

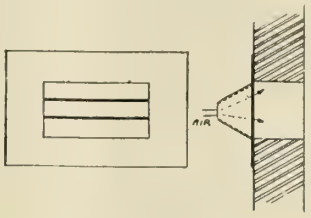


FIG. 28

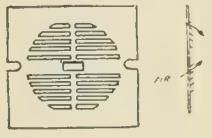


FIG. 29

ber enlarging toward the furnace; used in connection with the flat spray atomizer.

Fig. 29. Series of horizontal blades located on a flat plate over an area of circular form, the blades below the center driving the air upward and the blades above the center driving the air downward; used with flat spray burner.

Fig. 30. Series of vertical blades on a flat plate of oblong shape, the blades below the center driving the air to the left

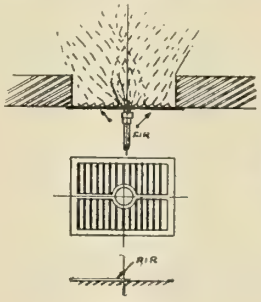


FIG. 30

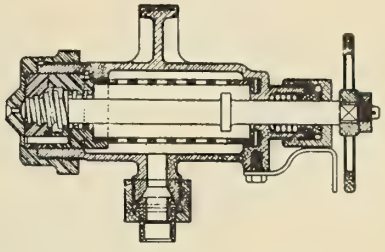


FIG. 31

and the blades above the center driving the air to the right; used with flat spray burner.

PRINCIPAL SYSTEMS USED

This review of the subject of mechanical atomization of oil would not be complete without some reference to the principal systems which have been installed in our torpedo-boat destroyers, and through the courtesy of the editor of the *Journal of the American Society of Naval Engineers* I am able to

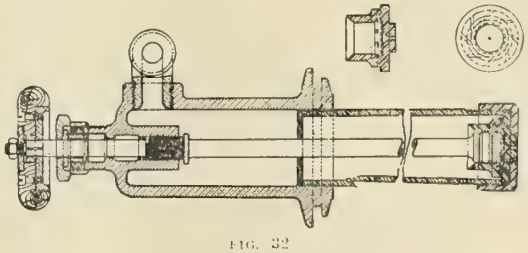


FIG. 32

reproduce illustrations of this apparatus which have been published in that periodical. I also extend my thanks to Mr. John Platt, consulting engineer; Mr. Chas. P. Wetherbee, vice-president of the Bath Iron Works; Mr. H. Brown, assistant to the president of the Fore River Shipbuilding Company; and the Schutte-Koerting Company for information relative to the apparatus in which they are interested.

Thornycroft (Fig. 31).—In this burner the oil receives a whirling motion by passing through a spiral groove into a central chamber communicating with the outlet orifice of the tip. The tip fits on to a nozzle in which there is a cylindrical

hole about the same diameter as the central chamber, and concentric with the axis of the burner. In the surface of this cylindrical hole a thread of square section is cut, of very slight depth at the end, coinciding with the central chamber in the tip, but increasing rapidly in depth toward the direction of the opposite end of the burner, at which the oil is admitted. A spindle fits into the cylindrical hole of the nozzle, and on this spindle there is a corresponding thread, accurately fitting the thread of the nozzle and tapering to practically nothing at the end. When the spindle is screwed home the thread on

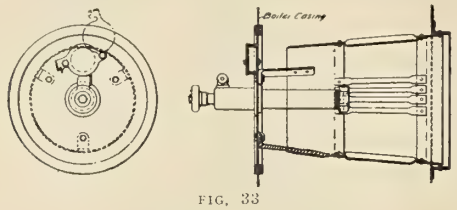


FIG. 33

the spindle bottoms on the tapered thread of the nozzle, and no oil can get to the tip. As the spindle begins to be unscrewed, however, the marked taper of the two threads causes them to separate and form in combination a spiral groove, the sectional area of which rapidly increases as the spindle continues to be unscrewed. The central chamber is formed by the combination of the end of the spindle and the burner tip. The output of this burner is controlled by the revolution of the spindle which regulates the area of the spiral oil passage.

The air for combustion is admitted through annular openings formed between concentric rings or short cylinders

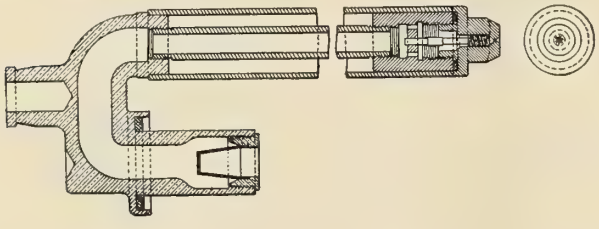


FIG. 34

strung together to form a sort of truncated cone, somewhat similar to the device shown in Figs. 18 and 19, except that the air is not directed toward the center.

Normand (Fig. 32).—Eight small ducts deliver the oil tangentially to the central chamber formed by the combination of the tip and an adjustable spindle. The chamber is recessed so that the movement of the spindle does not in any way close or affect the ducts, its office being, besides forming one wall of the chamber, to close or throttle the outlet orifice. In this burner the ducts and outlet passage and orifice are made in a single piece, which is held to the pipe or body of the burner by a clamp.

The air-distributing device or tuyere consists of a truncated cone of sheet iron fitted on a portion of its surface with blades for giving the air a whirling motion. (Fig. 33.)

Schutte-Koerting (Fig. 34).—The tip of this burner is chamfered out to receive a small spindle, less in diameter than the chamber except at the end, which is provided with a triple parallel thread which just fits the chamber and forms with the surface of the chamber three helical passages which deliver the oil to a smaller chamber at the end of the spindle, communicating with the outlet orifice. The spindle is not adjustable, the burner capacity being varied entirely by controlling the oil pressure and temperature. This burner is fitted with a yoke and hand screw which holds it in position and provides a ready means for disconnecting.

The air distributor is a truncated cone provided with longitudinal slots or openings which may be varied in area by means of a cover or register revolving on the outside and regulated by suitable mechanism. The air does not receive a whirling motion, the mixture with the oil spray being obtained by carrying a high air pressure and forcing it through the restricted area of the slots at high velocity.

Fore River (Fig. 35).—An adjustable spindle in this burner is arranged to throttle or close the outlet orifice and to vary the size of the central chamber to which the oil is delivered

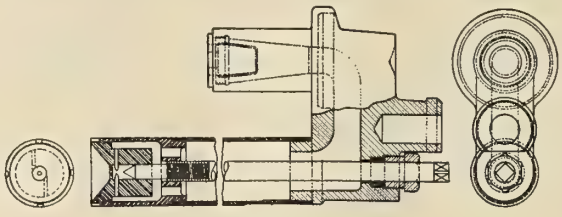


FIG. 35

through two tangential ducts, and the burner is provided with a quick detachable arrangement for holding in place.

The air distributor is a cone provided with air slots in the side which give the air a whirling motion, the area of these slots being controlled by regulating mechanism. The angle of the cone is about 60 degrees, which is much greater than that of any of the designs above described, and another difference lies in the fact that all the air enters through the slots and none around the burner. The slots, besides being so arranged as to give the air a whirling motion, are greater in area in the direction of the furnace.

Conclusion

In the preceding pages I have tried to show that while the problem of oil burning presents some difficulties, particularly as regards admission of air, there is very far from being any mystery about the matter. A strong leaning toward simplicity, "horse sense," and some experience, are a combination reasonably sure of giving good results, and I am not one of those who believe in very much abstruse reasoning or higher mathematics as a necessity. On the other hand, oil is not water, and the manufacturers of water sprinklers who have recently, under the stimulus of the times, entered the field of oil burning and steam generation, will find something more required than a table of steam properties and a few analyses of oil, and will certainly learn the fallacy of the theory that "It's all in the nozzle"—and a poor one at that.

Improvements will be required and will be forthcoming, particularly in connection with spraying the heavier oils, and I look to the flat spray atomizer as a promising field for development. Meanwhile the results already attained are certainly encouraging.

In closing I want to say one word of appreciation of the work of my associate, Mr. David J. Irish, who made so many of the tests referred to above. It was through his ingenuity and originality that our flat impeller plate was developed, and his enthusiasm and industry in carrying out the long and arduous series of experiments undertaken by the Babcock & Wilcox Company were a most important factor in the success of the work.

Ice-Breaking Car Ferry.—An ice-breaking car ferry to connect Prince Edward Island with the mainland is to be built by the Canadian Government at an early date. This vessel is being provided to overcome the slow and costly process of transshipping freight from the island railway to a steamer and again from the steamer to the railway of the mainland.

Lloyd's Summary of World's Shipbuilding

Lloyd's Register of British and Foreign Shipping has recently published its annual summary of shipbuilding throughout the world. This summary includes particulars of vessels of 100 tons gross and upwards, and takes into account only vessels that were launched in 1912, whether they were completed during the year or are still under construction. For this reason Lloyd's returns differ somewhat from those compiled from outside sources, where generally only those vessels completed during the year are considered and the smaller craft are included.

According to Lloyd's summary the total output of the world during 1912, exclusive of warships, appears to have been 2,901,769 tons (2,795,868 steam, 105,901 sail). This is an increase of about 252,000 tons over the figures for 1911. According to the latest information received by Lloyd's Register, the gross tonnage of vessels of all nationalities totally lost, broken up, etc., during the twelve months amounts to about 694,000 tons gross (520,000 steam, 174,000 sail). The net increase of the world's mercantile tonnage at the end of 1912 is thus about 2,208,000 tons. Steam tonnage has been increased by about 2,276,000 tons, while sailing tonnage has been reduced by 68,000 tons.

The warship tonnage launched in the world during 1912 amounts to about 535,000 tons displacement. This total, although 234,240 tons less than the huge output for 1911, exceeds the average annual tonnage launched during the nineteen years 1892-1910 by about 217,000 tons. Excluding one battleship intended for the Spanish navy, the average displacement of the battleships and cruisers launched during 1912 is no less than 24,645 tons.

Shipbuilding in the United Kingdom

Particulars of Total Output.—During 1912, exclusive of warships, 712 vessels of 1,738,514 tons gross (viz., 643 steamers of 1,720,957 tons and 69 sailing vessels of 17,557 tons) have been launched in the United Kingdom. The sailing ship tonnage is composed, however, almost entirely of barges and similar craft. The warships launched at both Government and private yards amount to 30 of 191,737 tons displacement. The total output of the United Kingdom for the year has, therefore, been 742 vessels of 1,930,251 tons. In these notes, warships are excluded from consideration except where they are specially mentioned.

The output of mercantile tonnage in the United Kingdom during 1912 shows a decrease of 65,330 tons on that of last year. As regards war vessels the total is 39,049 tons less than in 1911.

Practically the whole of the tonnage launched has been built of steel, and nearly 99 percent is composed of steam tonnage.

Comparison of Tonnage Afloat, 1911-1912.—Of the total output, over 76 percent, or 1,322,995 tons (1,313,683 steam tons and 9,312 sailing tons), has been built for registration in the United Kingdom.

In this connection it should be noted that, from the information at present in the possession of Lloyd's Register, the gross tonnage of United Kingdom vessels lost, broken up, etc., during the last twelve months appears to have been 308,000 tons (286,000 steam, 22,000 sail), while the sales to foreign and colonial owners have reached the record total of 704,113 tons (649,368 steam, 54,745 sail). On the other hand, 6,144 tons (5,196 steam, 948 sail) were built abroad for United Kingdom owners, and purchases from foreign and colonial owners during the same period amounted to 37,877 tons (36,462 steam, 1,415 sail).

The steam tonnage of the United Kingdom would thus appear to have increased by about 420,000 tons, and the sailing tonnage to have decreased by about 65,000 tons. The net increase of United Kingdom tonnage at the end of 1912 is therefore about 355,000 tons.

From the annual statements of the navigation and shipping of the United Kingdom, issued by the Board of Trade, showing the number and tonnage of vessels on the Register at the end of each year, which statements, however, take into account vessels of less than 100 tons, it appears that the net increases in the United Kingdom tonnage for the previous five years were as follows: 1907, 630,706 tons; 1908, 161,873 tons; 1909, 150,686 tons; 1910, 66,694 tons; 1911, 339,564 tons.

Vessels Launched for Abroad.—The amount of tonnage launched for abroad during 1912 was 415,519 tons, forming 23.9 percent of the total output, as compared with 22⅓ percent in 1911, 19½ percent in 1910, 24 2/5 percent in 1909, 40 percent in 1908, 34 percent in 1907, 20⅓ percent in 1906, 21½ percent in 1905, and 18⅔ percent in 1904. The British Colonies have provided the largest amount of work for the shipbuilders of the United Kingdom, viz.: 47 vessels of 72,970 tons (nearly 4 1/5 percent of the total output). Norway occupies the second position with 69,006 tons, being followed by Germany with 43,154 tons, Holland with 40,678 tons, Spain with 31,320 tons, and Austria-Hungary with 27,962 tons.

Size and Speed of Vessels.—The number of large steamers launched in the United Kingdom during 1912 has greatly exceeded the average of recent years. During the year 1892-96, 47 vessels of 6,000 tons and upwards were launched in the United Kingdom; in the following five years, 1897-01, the number rose to 166; in the next five years, 1902-06, 156 were launched, and during the five years, 1907-11, 167 such vessels were launched. Of vessels of 10,000 tons and upwards, only five were launched in the five years 1892-96, 32 were launched during the five years 1897-01, 29 were launched during the five years 1902-06 and 48 during the five years 1907-11.

The returns for 1912 show that 69 vessels of 6,000 tons and above were launched. Of these, 16 were over 10,000 tons each, the largest being the White Star steamship *Ceramic*, of 18,600 tons, and the Canadian Pacific steamers *Empress of Asia* and *Empress of Russia*, 16,850 tons each. The following are the other vessels of 11,000 tons and upwards, viz.:

	TONS GROSS
Nestor	14,200
Niagara	13,500
Darro	11,484
Desna	11,483
Drina	11,240
Beltana	11,120
Benalla	11,120
Kristianiafjord	11,000

The average tonnage of steamers launched in the United Kingdom during 1912 is 2,676 tons; but if steamers of less than 500 tons be excluded the average of the remaining steamers reaches 3,955 tons gross, which is a considerable advance on the mean of the averages of the previous five years.

Of the vessels launched in the United Kingdom 24 are capable of a speed of 16 knots and above. The fastest of these are the turbine vessels *Empress of Asia, Empress of Russia* and *Wahine*, two other turbine steamers intended for service on the Irish Channel and one for service on the Clyde, all designed for a speed of 20 knots.

Vessels Fitted with Turbines and Internal Combustion Engines.—Four steamships, viz.: *Ceramic, Niagara, Reina Victoria Eugenia* and *Infanta Isabel de Borbon*, with a total tonnage of 51,890 tons, are being fitted with a combination of tur-

bines and reciprocating engines. During 1912, including vessels mentioned in the preceding paragraph, 8 steamers were launched with a total tonnage of 42,261 tons which will have turbines only.

The launches for the year also include 11 vessels of a total tonnage of 6,000 tons with internal combustion engines, the largest being the *Fordonian,* of about 2,000 tons. These figures include the *Y. Ddraig Gôch,* of about 1,000 tons fitted with gas engines.

Other Special Types.—Of steamers building on the Isherwood system of longitudinal framing, 31 were launched during 1912, with a gross total tonnage of 153,702 tons. Including 6 of these vessels with a tonnage of 24,856 tons, there were launched during the past year 18 steamers of 90,222 tons for the carriage of oil in bulk. The returns also include 7 vessels of other special constructional design; 127 steam trawlers, whalers, and other fishing vessels; 83 dredgers and barges; 24 tugs, 5 yachts, besides a number of other vessels designed for channel, river and other special services.

Output of Leading Ports.—The Glasgow district occupies the first place among the shipbuilding centers of the country, showing an output of 338,954 tons. Then follow Newcastle with 317,654 tons, Sunderland with 305,734 tons, Greenock with 237,393 tons, Belfast with 161,261 tons, Middlesbro' with 143,570 tons, and Hartlepool with 121,725 tons. In warship tonnage Newcastle leads with 31,520 tons displacement, followed by Barrow with 30,120 tons and Liverpool with 28,400 tons.

Progress of Shipbuilding During the Year.—As regards the movement of the shipbuilding industry during the course of 1912, Lloyd's Register Returns show that, at the opening of the year, irrespective of warships, 1,519,052 tons were being built in the United Kingdom. The returns for the March quarter indicated an increase of about 168,000 tons in the work in hand; the June and September returns showed a further increase of about 87,000 tons, and 73,000 tons respectively. The amount of tonnage under construction at the end of December, which was 1,970,065 tons, is greater than any ever reached before and exceeds by 451,000 tons the amount at which it stood at the end of 1911. The total warship tonnage under construction in the country is now 496,875 tons displacement as compared with 408,755 tons twelve months ago.

Work in Hand at the End of 1912.—At the end of December there were under construction, including a number of vessels already launched but not completed, 69 vessels of between 6,000 and 10,000 tons, 25 of between 10,000 and 15,000 tons, 10 of between 15,000 and 20,000 tons, 2 of between 20,000 and 40,000 tons, and 2 of over 40,000 tons each.

Many of these are of special interest, among which are the following, not already named in the foregoing notes:

(*a*) The Cunard steamship *Aquitania,* of 45,000 tons; two Allan liners, of 16,000 tons each, and four other steamers of a total tonnage of 4,150 tons, all to be fitted with steam turbines.

(*b*) Nine steamers, with a total gross tonnage of 194,380

TABLE 1.—SUMMARY OF THE WORLD'S SHIPBUILDING OUTPUT FOR THE YEARS 1910, 1911 AND 1912

Where Built.	Description.	1910.		1911.		1912.	
		No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
United Kingdom	Merchant vessels	500	1,143,169	772	1,803,844	712	1,738,514
	Warships	45	134,645	50	230,786	30	191,737
	Total	545	1,277,814	822	2,034,630	742	1,930,251
Abroad	Merchant vessels	777	814,684	827	846,296	1,007	1,163,255
	Warships	77	176,209	119	538,083	144	342,892
	Total	854	990,893	946	1,384,379	1,151	1,506,147
	World's output	1,399	2,268,707	1,768	3,419,009	1,893	3,436,398

TABLE 2.—TABLE SHOWING THE TONNAGE OF VESSELS OF 100 TONS GROSS AND UPWARDS (EXCLUDING WARSHIPS) LAUNCHED IN THE UNITED KINGDOM AND ABROAD DURING THE LAST DECADE

Year.	United Kingdom.	British Colonies.	Austria-Hungary	Denmark.	France.	Germany.	Holland.	Italy.	Japan.	Norway.	United States.	Other Countries.	Totals.	
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	No.	Tons.
1903	1,190,618	34,690	11,328	28,609	92,768	184,494	59,174	50,089	34,514	41,599	381,820	35,928	1,650	2,145,631
1904	1,205,162	30,965	16,645	15,859	81,245	202,197	55,636	30,016	32,969	50,469	238,518	28,254	1,643	1,987,935
1905	1,623,168	10,798	16,402	17,557	73,124	255,423	44,135	61,629	31,725	52,580	302,827	25,554	1,576	2,514,922
1906	1,828,343	26,042	18,590	24,712	35,214	318,230	66,809	30,560	42,489	60,774	441,087	26,913	1,836	2,919,763
1907	1,607,890	46,443	8,717	28,819	61,635	275,003	68,623	44,666	66,254	57,556	474,675	37,807	1,788	2,778,088
1908	929,669	34,181	23,502	19,172	83,429	207,777	58,604	26,864	59,725	52,839	304,543	32,981	1,405	1,833,286
1909	991,066	7,461	25,006	7,508	42,197	128,696	59,106	31,217	52,319	28,601	209,604	19,276	1,063	1,602,057
1910	1,143,169	26,343	14,304	12,154	80,751	159,303	70,945	23,019	30,215	36,931	331,318	29,401	1,277	1,957,853
1911	1,803,844	19,662	37,836	18,689	125,472	255,532	93,050	17,401	44,359	35,435	171,569	27,291	1,599	2,650,140
1912	1,738,514	34,790	38,821	26,103	110,734	375,317	99,439	25,196	57,755	50,255	284,223	60,622	1,719	2,901,769

TABLE 3.—TABLE SHOWING THE NUMBER AND DISPLACEMENT OF WARSHIPS OF 100 TONS AND UPWARDS LAUNCHED FOR THE VARIOUS NAVIES DURING THE LAST DECADE

Year.	British.		United States.		Austro-Hungarian.		French.		German.		Italian.		Japanese.		Russian.		Other Flags.		Total.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
1903	38	147,813	13	66,140	2	17,520	15	30,760	16	60,590	..	.....	17	13,917	9	38,430	9	15,930	119	391,100
1904	33	126,375	14	170,185	3	11,480	9	43,600	11	44,970	4	25,932	4	608	5	1,750	19	10,106	102	435,006
1905	23	96,505	7	98,200	3	11,020	7	28,611	6	36,487	10	14,490	17	50,633	37	15,721	8	11,544	118	363,211
1906	23	85,700	5	45,443	10	2,760	6	15,183	17	62,678	14	3,039	24	41,277	19	82,204	30	24,688	148	362,972
1907	33	133,405	5	11,590	7	1,594	17	33,594	17	14,800	12	25,154	10	57,200	17	35,317	24	8,557	142	321,211
1908	26	49,560	8	52,850	8	16,153	22	21,600	16	97,660	5	29,400	4	2,245	11	8,800	27	31,421	127	309,689
1909	35	98,790	15	48,639	23	22,217	19	95,740	27	99,116	8	2,088	1	375	2	1,246	21	36,264	151	404,475
1910	43	133,525	13	30,287	8	14,993	12	24,063	21	49,024	4	19,374	3	23,100	..	.....	18	16,488	122	310,854
1911	41	221,430	13	57,526	2	20,269	15	53,995	28	128,340	15	75,018	6	37,071	5	93,260	44	81,960	169	768,869
1912	28	163,087	15	62,673	7	49,361	21	55,965	30	99,810	35	14,939	4	56,035	1	492	33	32,267	174	534,629

tons, which will all be fitted with a combination of steam turbines and reciprocating engines, viz.: *Britannic,* 50,000 tons, White Star Line; one, 32,500 tons, Holland-Amerika Line; one, 27,000 tons, Red Star Line; two, 29,900 tons, Royal Mail S. P. Co.; two, 31,200 tons, Pacific Stm. Nav. Co.; one, 14,980 tons, Geo. Thompson & Co.; one, 8,800 tons, McIlwraith, McEacharn & Co.

(*c*) Two vessels of between 3,000 and 4,000 tons each, besides a number of small craft, for which the propelling power will be internal combustion engines.

(*d*) Forty steamers to carry oil in bulk with a total tonnage of about 231,000 tons.

(*e*) Forty-six steamers of about 267,000 tons which are building on the Isherwood longitudinal framing system. Thirty-one of these vessels, of about 194,000 tons, are oil-carrying vessels, and are included in the figures given in paragraph (*d*).

Shipbuilding in Foreign Countries

Particulars of Total Output.—There have been launched abroad, during the year, 1,007 vessels of 1,163,255 tons (720 steamers of 1,074,911 tons and 287 sailing vessels of 88,344 tons). These figures show the very large increase of about 317,000 tons as compared with those for 1911. Among foreign countries, the leading places are held by Germany with 375,317 tons, the United States with 284,223 tons, France with 110,734 tons, Holland with 99,439 tons, Japan with 57,755 tons and Norway with 50,255 tons.

The returns for the year include 36 vessels of between 4,000 and 6,000 tons; 27 of between 6,000 and 8,000 tons; 9 of between 8,000 and 10,000 tons; and the fast turbine steamer *Imperator,* of about 52,000 tons, launched in Germany. In addition, 4 colliers of about 10,000 tons each were launched for the United States Navy. During 1912 seven vessels of over 3,000 tons each, to be fitted with internal combustion engines, were launched abroad. Their aggregate tonnage amounted to about 30,000 tons. Two other vessels of over 1,000 tons each, and a large number of vessels of small tonnage similarly fitted were also launched. The output abroad for the year also includes 10 oil-carrying steamers of a total tonnage of 44,154 tons.

The total output of war vessels abroad, which comprised 144 vessels of 342,892 tons displacement, shows the large decrease of over 195,000 tons displacement as compared with the figures for the preceding year.

Germany.—The returns show an increase of nearly 120,000 tons in the shipbuilding output as compared with last year, and the figures (375,317 tons) are about 57,000 tons higher than the total built in 1906, which was the previous highest on record. As usual, the figures do not take into account a large number of river craft launched at yards situated on the upper rivers.

Twenty-eight steamers of 5,000 tons and under 10,000 tons were launched in the country during 1912. In addition there was launched at Hamburg the Hamburg-American liner *Imperator,* of about 52,000 tons gross, the largest vessel up to date.

The total output includes five vessels of 18,258 tons fitted with internal combustion engines, the largest being the oil-carrier *Hagen,* 5,810 tons, and 10 other vessels with similar engines, of an average tonnage of 271 tons.

There were under construction at the end of December, one turbine steamer of about 58,000 tons, one steamer of about 35,000 tons, three of between 20,000 and 25,000 tons (one of them to be fitted with turbines), two of between 10,000 and 15,000 tons, and thirty other vessels of between 5,000 and 10,000 tons each, including eleven built to carry oil in bulk, three of which will be fitted with internal combustion engines.

United States.—The tonnage reported from the United States, which amounts to 284,223 tons, is over 112,000 tons higher than that of the previous year. The bulk of this increase is due to the greater activity of the shipyards on the coast. The tonnage launched on the Great Lakes amounts to nearly 90,000 tons, and includes six vessels of over 5,000 tons, the largest being of about 8,600 tons. On the coast there were only launched four sea-going merchant steamers of between 5,000 and 7,000 tons each, and four naval colliers of about 10,000 tons, one of which, the *Jupiter,* is to be driven by electric motors worked by an alternator connected to steam turbines. Besides the above vessels there were building at the end of 1912 eleven merchant steamers of between 5,000 and 9,000 tons each.

France.—The present returns, 110,734 tons, show a decrease of nearly 15,000 tons as compared with the tonnage launched during 1911. The figures include six steamers of over 5,000 tons, the largest being the *Mississippi,* of about 7,000 tons; also the turbine channel steamer *Rouen,* 1,656 tons, designed for a speed of 22 knots. The work in hand at present amounts to over 175,000 tons. This total comprises ten steamers of from 5,000 to 9,000 tons, and four of between 12,000 and 15,000 tons, two of which will be fitted with a combination of turbines and reciprocating engines.

Holland.—The total tonnage, aggregating 99,439 tons, launched in Holland during the past year exceeds by over 6,000 tons the figures for 1911, and are the highest ever recorded in the Society's Returns for that country. This total does not include vessels known to be exclusively intended for river navigation. From the returns received it appears that the tonnage of steamboats, barges, and other river vessels launched during 1912 amounts to more than 90,000 tons.

The largest vessels launched were three of between 6,000 and 7,000 tons each. The output also includes two vessels of a combined tonnage of 7,157 tons and seventeen small vessels, none of which exceeds 350 tons, all to be fitted with internal combustion engines.

There are now building five other steamers of between 7,000 and 9,000 tons. Two large cargo steamers, 4,500 tons each, are also in hand to be fitted with oil engines.

Japan.—The tonnage launched during the year, amounting to 57,755 tons, shows a fairly large increase on the output of 1911. It is, however, mostly composed of small vessels, with the exception of two steamers of about 6,500 tons each.

Austria-Hungary.—The returns show a very slight increase in the output of this country. The present figures, 38,821 tons, however, are composed almost entirely of vessels of between 5,000 and 8,000 tons. At the end of 1912, there were under construction, but not yet launched, over 57,000 tons of new vessels, including one of nearly 15,000 tons.

Norway.—The output for the year amounts to 50,255 tons, which is nearly 15,000 tons more than that of 1911. There is no special feature of interest in the returns, which, as in recent years, comprise a very large number of small vessels. Only eight steamers of between 1,500 and 1,800 tons were launched.

Other Countries.—The output of the British Colonies, amounting to 34,790 tons, is 15,000 tons more than that for 1911. Only a very small part of the increase, however, consists of sea-going tonnage.

Denmark, with 26,103 tons, shows an increase of over 7,000 tons on the total for 1911. Included in this total are two vessels of 4,934 tons and 3,716 tons, fitted with Diesel engines. This method of propulsion is being adopted in the cases of several cargo vessels of considerable size building in this country.

The figures for Italy, 25,196 tons, are 8,000 tons more than those of 1911. It may be mentioned that the total tonnage now building, 52,370 tons, is over 33,000 tons higher than that in hand at the end of 1911.

Work in Hand at the End of 1912.—At the end of December there were under construction abroad 1,368,671 tons gross

(1,337,078 tons steam and 31,593 tons sail). Germany occupies the first position with 542,519 tons, and next come the United States with 236,185 tons, France with 175,588 tons, and Holland with 114,811 tons. These figures are exclusive of vessels for service on inland rivers. Of vessels the construction of which had been actually commenced but which were not yet launched, there were seventy-three steamers of between 5,000 and 10,000 tons, thirty of which are building in Germany; seven steamers of between 10,000 and 15,000 tons, and five steamers of over 20,000 tons, all in Germany, the largest being of about 58,000 tons and 35,000 tons, respectively. These figures include three vessels aggregating 96,000 tons, to be fitted with turbines, three of 39,000 tons with a combination of turbines and reciprocating engines, and six of 33,000 tons to be fitted with internal combustion engines. There are also four other vessels building on the Continent of between 3,000 and 5,000 tons each, to be fitted with this latter type of engine.

Comparison of Output in the United Kingdom and Abroad

The returns under review show that although the activity which has characterized the shipbuilding industry in the United Kingdom throughout the year 1912 has never been equaled before, the amount of tonnage actually *launched* during the twelve months for various reasons fell below the total output of 1911 by some 65,000 tons.

Foreign shipyards, however, have achieved a record output during 1912, having launched no less than 317,000 tons of merchant vessels in excess of the tonnage put into the water during 1911.

The highest foreign individual increases for the year are: United States, 66 percent; Germany, 50 percent, and Italy, 45 percent.

Of the tonnage launched in the world during 1912, the United Kingdom has acquired 45.8 percent, while 60 percent was launched in the United Kingdom. If, however, only *seagoing merchant steamers* of 3,000 tons gross and upwards be taken into account, out of the total of 367 such steamers, of 2,019,763 tons, launched in the world, 71.3 percent of the tonnage has been launched in the United Kingdom.

Subsidies Aid Swedish Shipping

To afford direct communication with distant ports and to encourage commerce, and especially the export trade, the Swedish Government has within the last few years instituted a system of subsidies in aid of privately owned Swedish steamship companies. These subsidies are equivalent to a bounty or premium paid by the government, which, at financial risk and uncertainty as regards the eventual success of the proposed lines, has undertaken the building of the ships necessary to maintain such frequent communication as will answer to the commercial and industrial requirements of the country.

These subsidies are entirely apart from the so-called "State contributions," which provide for loans to shipowners from government funds. To show the extent with which at present the distant port foreign commerce is carried on from Sweden, names of companies, countries traded with, and other particulars are herewith given.

The Swedish Asiatic Company, Ltd., with a capitalization of about $675,000 (£138,500), operating with six steamers between Gothenburg, Sweden, and Port Said, Singapore, Hongkong, Shanghai, Yokohama, Kobe and Moji. These boats are about 9,000 tons carrying capacity, having 2,800 horsepower with a speed of about 11 knots. This company has received subsidies since 1907 at the rate of $81,500 (£16,700) per year, the main offices being situated at Gothenburg under the direction of Mr. Dan. Bostrom, whose companies now control a very large percentage of Sweden's shipping interests.

The Axel Johnson Company, of Stockholm, with a capitalization of about $1,350,000 (£278,000), operates four boats of about 6,600 tons carrying capacity, and in addition is building four more to be equipped with Diesel motors for a speed of 11 knots. This company operates its steamers between Sweden and Argentina and receives subsidies yearly equal to those of the Swedish East Asiatic Company, Ltd.

Transatlanticka Balaget, of Gothenburg, operates six steamers of about 7,500 tons carrying capacity, having a speed of 10 knots, and is capitalized for about $950,000 (£195,000). It keeps up regular communications between Sweden and South Africa and will receive subsidies commencing 1913 amounting to about $42,000 (£8,620) yearly.

Svea Balaget, of Stockholm, capitalized for about $675,000 (£138,500) operates between Sweden and Russia, and receives yearly subsidies of $27,000 (£5,550).

The Melike-Amerika Linen started direct communications between Sweden and Mexico and America recently, with four new boats ranging in size between 6,000 and 7,000 tons carrying capacity. This line is receiving subsidies yearly amounting to $81,000 (£16,600) to run for a period of three years from Jan. 1, 1913.

The principal goods of export from Sweden consist of lumber, both finished and unfinished, granite stones for pavements, paper and pulp from which paper is made, bar iron, pig iron, matches, dairy products, machinery and acids. The imports carried by the steamers engaged in the trades referred to are: Cotton, sugar, beans, tea, grain, coffee, sugar and wool. The foregoing companies are financed principally by Swedish capital, the ships being manned by Swedish officers and crews. The administrations and operations are controlled entirely by the companies from their main offices at Gothenburg and Stockholm.

The enormous increase in the export trade in goods, which formerly was carried on on a small scale only in sailing vessels, is due to the regularity and the greater rapidity with which transportation under reasonable government aid is now carried on. The lessening of cost in transportation due to savings in transshipment plays an important role in enabling Sweden to compete in the world markets with other and more fortunately situated countries. This applies principally to goods produced in the industrial arts.

The following review, giving an average of the items with respect to salaries and subsistence expenditures, and which largely constitute so-called running expenses, is interesting to note:

Salary of captains, yearly	$2,000.00	(£411.00)
Salary of chief officer, monthly	45.00	(9.25)
Salary of second officer, monthly	40.00	(8.21)
Salary of third officer, monthly	33.00	(6.78)
Salary of chief engineer, monthly	81.00	(16.65)
Salary of second engineer, monthly	58.00	(11.70)
Salary of third engineer, monthly	48.00	(9.86)
Salary of fourth engineer, monthly	27.00	(5.54)
Salary of fireman, monthly	17.00	(3.50)
Salary of crew, average, monthly	14.00	(2.88)
Subsistence per man per month	11.50	(2.36)

The subsidies paid by the Swedish Government are purely trade bounties and do not cover any premiums on the construction of vessels, nor are they in the form of naval subventions whereby merchant ships are constructed to conform with certain naval requirements, making them available for naval service.

Unfortunately for Swedish shipbuilding interests no reference is included in the laws governing these trade bounties as to domestically or foreign-built ships.

Strange as it may seem, it is nevertheless a fact that the shipbuilders in Sweden, a country with almost an inexhaust-

ible supply of the raw material from which the best iron and steel in the world may be produced, are not in a position to build steel ships as cheaply as some other European countries, especially England. The reason for this lies, not in the difference in the wage scale, as in the United States, but in the increased cost of the Swedish finished materials, such as plates, bars, and shapes over similar materials produced in the country above mentioned. Therefore, a large number of the ships used in the distant port trade are foreign built.

The principal reason for the enhanced cost in steel produced in Sweden will be found in the almost complete absence of coal in the country, which is essential for the cheap reduction of iron ore. The best Swedish iron is reduced from the ore by using charcoal, a process which is greatly limited.

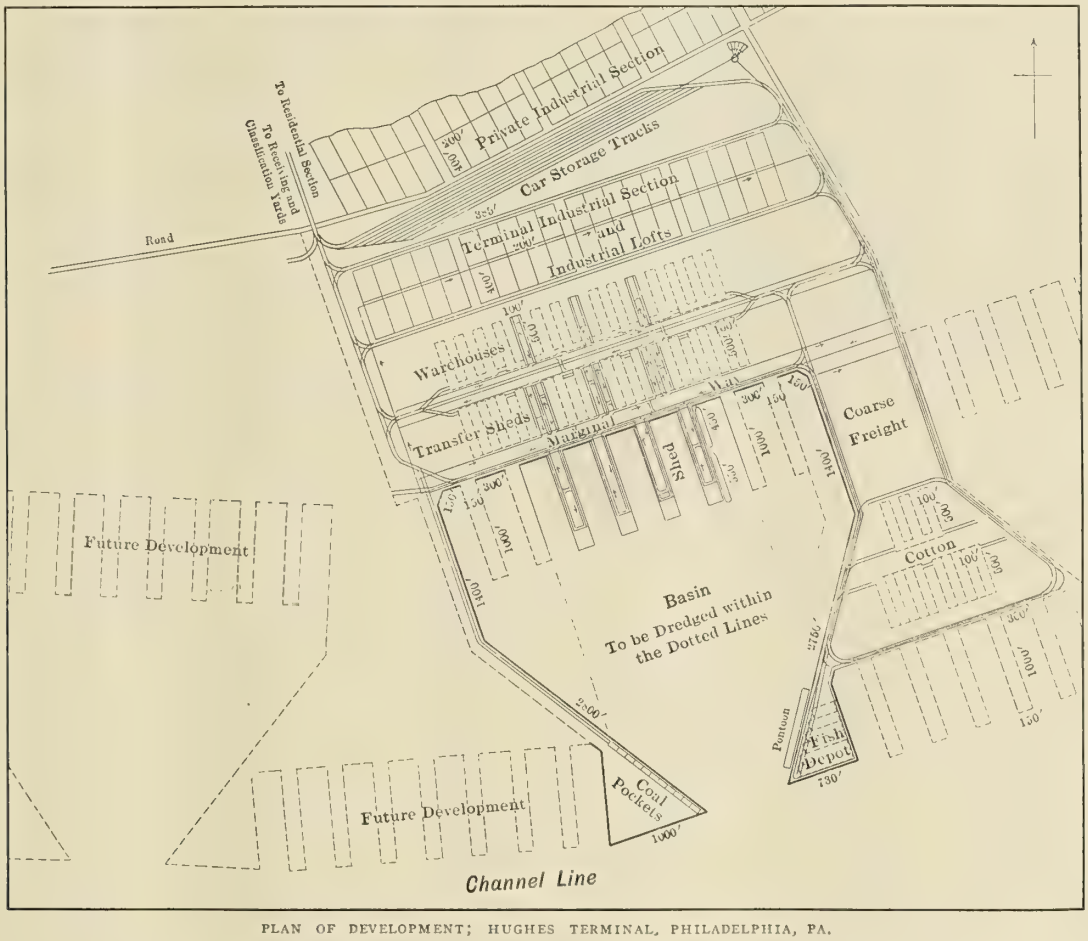
New Steamship Terminal at Philadelphia

BY H. McL. HARDING*

Plans have been made for the establishment of a new steamship terminal, to be known as the Hughes Terminal, at an advantageous point on the Delaware River about eighty miles from the sea and about eight miles from the Philadelphia city hall, contiguous to the boundary line of the city. The site comprises about 2,500 acres between a trolley road which runs parallel with the shore line of the river and the present shore line, the islands in front of this land, the whole of Tinicum Island and the submerged lands which are part of the Tinicum Island property. Besides this there will be about 500 acres beyond the trolley road.

In the first layout as planned, there will be about 20,000 feet of lineal frontage, or berthing capacity at one time for some forty vessels 500 feet in length. There will be two piers, each 1,000 feet in length. There is space for eight 1,000-foot piers within the basin. In future development, each new basin will have practically the same lineal pier and quay length, the three basins therefore having a lineal frontage of 60,000 feet.

There can be five river piers, with 10,000 feet frontage, in front of the cotton area. Other river piers can give 24,000 feet additional. Furthermore, there can be developed a frontage upon both sides of Tinicum Island west of the terminal proper development. It will, therefore, be seen that there will be a surplus of frontage for many years to come. The western end of Tinicum Island will probably be used for transshipment sheds, warehouses or manufacturing lofts in future development.



PLAN OF DEVELOPMENT; HUGHES TERMINAL, PHILADELPHIA, PA.

The Waterway

There is at present a depth of 30 feet in the channel, and an appropriation has been made by the Government to increase this channel to 35 feet in depth and 800 to 1,000 feet in width. The river, opposite the present terminal shore line, to the New Jersey shore is a mile and a quarter wide. It will be noticed that there is not only ample land area, but also water area for all terminal requirements, including not only anchorage, but also ship-turning space. All the basin will not at first be dredged to the depth of 30 feet, but the portion

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between the dotted lines and along the right-hand quay wall. The depth of the rest of the basin will be made sufficient for tugs, barges, lighters and small vessels. The plan of the basin and piers is so designed as to afford easy egress and ingress for steamships.

General Terminal Capacity

It is estimated conservatively, by making use of the latest mechanical appliances, that there should be an annual transferring capacity at the 20,000 lineal feet of pier and quay walls of about 4,000,000 tons.

Delaware River Piers

There will be noticed groups of piers, some within the basins and others along the Delaware River. The basin piers will be first constructed, and later, as required, the river piers. When the river piers are constructed, warehouses can be built within the space now designated as occupied by coarse freight. Other locations can then be set aside for coarse freight or that not affected by the weather. This arrangement of the two sets of piers with the connecting quay walls gives, under the existing physical conditions, the greatest capacity at the least expense.

Divisions for Different Commodities

Provision must be made for the prompt transferring of miscellaneous cargoes with many marks and cross marks; of cargoes of one commodity, such as cotton, but with a number of marks; cargoes of one kind and one mark, such as lumber or logs, and also—that which is of great importance—bulk cargoes of coal, rock, ore and similar material. It is, therefore, advisable that certain locations be designated, and, as far as is practicable, be reserved for these different commodities.

There should also be reserved to a less degree separate berths for foreign and for coastwise ships, and also for the so-called "tramps" and the barges and lighters. A lighter or barge may not require more than 10 or 12 feet draft, and therefore should not occupy berths required for foreign or coastwise freighters drawing over 20 feet.

The Surface Railroad Tracks

It is the purpose to transfer the freight as far as practicable directly to cars upon tracks behind each pier or quay. This may be from the ship's hold, from the ship's deck, or from the pier's side. Proper consideration will be given in this connection to customs regulations, assorting and distributing. In order to do this without rehandling, which would add some 15 to 20 cents (7½d. to 10d.) per ton to the transference cost for miscellaneous freight, it is necessary to have trackage for a sufficient number of cars in connection with each one or two combined sections of the terminal not less than placement for 300 cars, so as to avoid more than one handling.

In the storage yards to the north of the terminal will be trackage for over 900 additional cars, and more trackage in other locations. Trackage is also provided for cars within the sheds and warehouses, between the sheds and warehouses, and between the warehouses and the industrial section, and the number of tracks in the storage yards can be largely increased. Space can readily be reserved still further to the north of and within the terminal grounds for classification and transfer yards. A successful terminal requires ample trackage and car room, as is well known to all transportation managers.

Between each of the four lines of tracks serving the piers and quays are platforms about 20 feet in width. This enables the cars to be loaded and unloaded without the tedious and laborious "spotting." Many sidings will be so arranged, not only for l. c. l. freight, but also for full carloads, and for the local team freight. In this preliminary plan, for the sake of clearness, all of these tracks are not shown. Miscellaneous freight is generally shipped in box cars. Bulk freight and structural steel being often shipped in open cars, should be loaded and unloaded without rehandling. In general, it may be said that the question of ample room for tracks and their locations has received careful study and consideration.

No successful terminal has proved to be too large, and all the available space here will sooner or later be needed. It therefore seemed advisable for the tracks to pass through the lower story of the sheds. Another advantage of this is that the handling and transferring of the freight are done under cover, avoiding horizontal movements, whereby the work can proceed during inclement weather and the property be protected from damage and also from thefts. It is also proposed to extend the sidings through a portion of the lower story of the warehouses for similar reasons, and for the direct elevation of the freight to the upper story or stories; but tracks are not to be extended within the pier sheds or upon the piers, except possibly on special piers for the transference of bulk freight or cargoes of few marks. For miscellaneous or package freight service, it is not advisable that cars should pass upon the piers.

Internal Water Area

The basin, as located, adds to the value of all the other terminal sections. Not only will it be an anchorage place for barges and lighters, but as a temporary mooring place for even the longer vessels. Its quay walls can give berthing space for foreign and domestic steamships, and the quay walls on the right and left of the basin are admirably situated for lighterage service.

One basin slip has been indicated as dredged within the eastern portion of the basin, about 2,600 feet long and 300 feet wide. The reason for this is that it seems to be excellently well adapted for special freight and for transference to the local industries by railway or transfer tracks. As there must be a location where certain classes of cargoes can be transferred directly between ships and lighters, the basin can be used for this purpose.

Although there seems to be an excess of frontage, yet it is recommended that none of the water front, as shown improved, be long-leased or sold for private occupancy. It will all be needed. Furthermore, under long leases, walls and piers are often allowed to deteriorate, and this affects the value and appearance of the whole terminal. It will always be of more value and use if used by the terminal and its tenants under the direction of the Terminal Company. This recommendation does not apply to lands outside the terminal proper. It is preferable to follow the methods of Liverpool and other foreign terminals in this respect.

Marginal Way

A strip of land 200 feet in width, in front of the transfer sheds and called the marginal way, is reserved for the common use of all the factories and the whole terminal and for surface tracks and overhead runways.

Transshipment Sheds

In the basin section these sheds are upon the piers. Only two sheds will be constructed at first. These transshipment pier sheds will be of one story, about 40 feet in height, 138 feet in width and 800 feet long. They will be fully equipped with freight-tiering and transferring machinery. To the east of the basin will be other transit sheds in the future 100 feet wide and 500 feet long, of the two-section type. These are chiefly for the transference and storage of cotton and similar material, which, on account of the fire risk, it is desirable to isolate.

Transfer Sheds

To the rear of the marginal way are the transfer sheds for the transference to or from the cars or drays, and for a shorter time storage than for warehouse storage.

Warehouses

Towards the north of the transfer sheds, between them and the industrial section, will be located warehouses. Only two warehouses need be constructed at first.

Machinery Conditions

Later devices consist in overhead trackage and transferring and hoisting machinery. The power is electricity, preferably of direct current. This can be purchased economically from the local electric light and power companies.

This conveying mechanism consists of a transfer tractor which draws after itself from one to four trailers, each trailer supporting an electric hoist. This transfer tractor constitutes the traveling conveying mechanism, having a speed up to 9 miles an hour with its complement of trailers and 6 tons of freight. It is controlled in the same way as an electric trolley car, by a transferman in the transfer tractor cab operating a drum controller, the current being taken by a contact wheel from a wire or other conductor located parallel to the track in the most convenient location, or in some special cases by a storage battery attached to one of the trailers.

Each trailer has supported beneath it an electric hoist, which might be called a traveling electric winch. It has all the functions of the winch except that it is movable. The normal load of each hoist is 2 tons at a speed of 60 feet per minute. There is a reserve capacity of 50 percent. Two hoists combined can lift 4 tons.

Advantages of such a Terminal

The same advantages that the city of Philadelphia enjoys will apply to this terminal. The proximity of the terminal to the great iron, coal and oil fields of Pennsylvania will make this large, modern mechanically equipped terminal a national point for vast and ever-growing manufacturing enterprises.

A Large Commercial Motor Boat

An unusually large gasolene (petrol) driven boat, which is named the *Radium,* was recently built by the Skinner Shipbuilding & Dry Dock Company, Baltimore, Md., and is now in the service of the Gulf Refining Company. Her dimensions are 153 feet length over all, 23 feet 10 inches beam and 12 feet 6 inches depth.

The vessel is built of steel throughout with the exception of the upper deck house, which is of wood and includes the pilot house, captain's room and cook's room. The lower house is of steel and includes the upper engine room, the entrance to the pump room, storeroom, engineer's room, deck hands' quarters and the galley. All of these quarters are located in the after part of the vessel and are well lighted and ventilated.

In the hull of the vessel there are five main transverse bulkheads and one vertical fore-and-aft bulkhead, all made oil-tight and providing eight compartments for cargo oil. The cargo oil is pumped from these compartments by four Gould "Pyramid" pumps, 6 inches by 12 inches, located in the upper engine room and connected by belt to a 20 horsepower horizontal gasolene (petrol) engine. These pumps can be arranged to be thrown in or out of gear by Orton clutches worked by levers. The suction and discharge of these pumps is 4 inches in diameter, and all valves in the cargo lines are 4-inch iron body brass-trimmed flanged gate valves.

The *Radium* has a displacement of 750 tons and on her trial trip, loaded, showed a speed of 8.4 knots. She has a fuel capacity sufficient for a radius of 1,800 nautical miles. The propelling machinery consists of a Standard air-starting and reversing single-acting gasolene (petrol) engine rated by the manufacturers, the Standard Motor Construction Company, Jersey City, N. J., as a 300 horsepower size, but which has been found capable of developing considerably greater horsepower. Two fuel tanks are located under the cargo pump space, having a capacity of 6,966 gallons. There is also a cylindrical tank in the engine room of 1,124 gallons capacity and a small tank for the pumping engine of 53 gallons. The total capacity of fuel tanks is therefore 8,143 gallons. Two air tanks, 18 inches diameter by 8 feet long, with a total capacity of 27.4 cubic feet, are located under the main deck in the engine room for supplying air for starting and reversing the

OIL TANKER RADIUM, DRIVEN BY GASOLENE (PETROL) ENGINES

main engine and for auxiliary purposes. In the after end of the engine room there is a fresh water tank of 507 gallons for supplying the galley. The vessel is lighted by a 2 kilowatt 7½ horsepower Standard gasolene (petrol) auxiliary engine, attached to which is a bilge pump and air compressor.

Cross-Channel Steamers Equipped with Frahm Anti-Rolling Tanks.—The two new turbine steamers which are now being built for the Dover-Ostend service of the Belgian State Railways will be equipped with Frahm anti-rolling tanks. These are the first vessels engaged in the cross-channel traffic which are thus equipped. The installation of this device is expected to reduce the rolling of the vessels to an angle of not more than two or three degrees.

Motor Ship for the Atlantic Transport Company.—Announcement has been made recently that the Atlantic Transport Company is to place an order with Messers. Harland & Wolff, Ltd., Belfast, for a motor vessel of 7,100 tons displacement, to be equipped with six-cylinder, four-cycle Burmeister & Wain Diesel engines.

Petroleum Production in the United States.—According to figures published recently by the United States Geological Survey, the production of petroleum in the United States in 1911 was 220,449,400 barrels. The production estimated for 1912 was 220,200,000 barrels.

First Voyage of the Imperator.—Announcement has been made that the 50,000-ton Hamburg-American liner *Imperator* will sail on her first trip from Hamburg May 28.

McAndrew's Floating School

BY CAPTAIN C. A. McALLISTER*

CHAPTER VI
Boilers

"We have now covered the most important of the fundamental subjects which all engineers should know, so we will begin on the subjects relating to the parts you are most interested in, that is, those with which you have already had some practice. I will therefore ask you what, in the opinion of each, is the most important thing to take up."

"Propellers," promptly replied Pierce; "they drive the ships."

"No, sir," said Schmidt, "let's take up the engines, for they drive the propellers."

"I think we ought to begin with boilers, sir," remarked Nelson; "they furnish the steam which drives the engines."

"Ah!" said O'Rourke, "if that's the reason, let's take up 'the walking of the ghost' when he comes across with the money that makes 'em all go."

"Nelson," said McAndrew, "has the right idea—the boilers are the most important parts of marine steam machinery. If you don't get the steam first, no matter how good the engines and propellers may be, the ship will not move.

"I have already told you what happened when coal is put in the furnaces, and now we want to know something about the boilers that hold the steam after it is made. How many kinds of boilers are there, O'Rourke?"

"Two, sir," replied that youngster; "tight ones and leaky ones."

"Well, that's a good distinction, but hardly the kind that we want to talk about, although I'll admit that a tight boiler of any description is better than any kind that leaks. If you were to study books on the subject you would have to read descriptions of a dozen types of shell boilers, but as there is practically only one type used on steamers nowadays, any knowledge you might gain about discarded types would be as useful to you as last year's bird nests. The principal type of shell boiler all marine engineers in the merchant service have to deal with now is the Scotch type—single or double-ended. By the time you boys get to be chief engineers even that type will probably be put on the shelf, as the day of the use of watertube boilers is fast approaching. However, as the Scotch boiler is just at present the principal one to be considered, we will give that first attention. This boiler is named, probably, from the fact that it was first developed by Scotch shipbuilders, than whom," said McAndrew, evidently taking pride in his ancestry, "there are no better in the world.

"Up to the present time it has stood the test of service better than any others of the class of shell boilers, and has consequently lived to see the others discarded. Theoretically, an ideal shell boiler, to withstand internal pressure, would be one shaped like a sphere or ball, as curved surfaces need no bracing; flat surfaces should be avoided in boiler work, and the principal feature of a Scotch boiler, which makes it so efficient, is that there are as few flat surfaces as possible. The shell of the boiler is made cylindrical, the furnaces are cylindrical, as also, of course, are the tubes. Consequently, the only flat surfaces are the heads and portions of the combustion chambers.

"The thickness of the boiler shell depends upon three things: the steam pressure to be carried, the diameter of the boiler and the strength of the material used. The steam pressure has gradually been increased, so that now it is not uncommon to find Scotch boilers carrying from 200 to 250 pounds pressure; the diameter has increased so that boilers 16 to 18 feet in diameter are not rare. The time is not far distant when the shells will have to be so thick as to make this type impracticable; then you will see the watertube boilers come into greater use.

"In the early days of steam machinery, boiler building was a crude art. Compared with modern methods of construction it was in about the same relation as early wooden shipbuilding bears to modern steel shipbuilding. If a ship carpenter made anything that came within a half inch of the dimensions of the stick of timber he was shaping, he was supposed to be quite accurate. Old-time boiler makers were just about as crude; they rarely had drawings to follow, a rough sketch on a blackboard in the boiler shop sufficing; holes were always punched, and the drift-pin was used almost continuously. While such methods were all right for boilers using low steam pressures, they would not do nowadays at all. With the high steam pressures now used, and the large size of the boilers, nothing but accurate design and good workmanship will do. In the early days of boiler construction all rivets were driven by hand; now nearly all rivets are driven by hydraulic pressure of 15 to 30 tons, and even with that it is almost impossible to keep some of the seams and rivets from leaking.

"Here is a drawing (Fig. 1) of a typical small Scotch boiler which will show the general features of this type. It consists essentially of four steel plates rolled up into the form of a cylinder which is known as the shell of the boiler. Each portion of the shell is known as a course. The courses are lapped over one another and riveted together by what are known as lap joints. The longitudinal seams come together and are joined by straps or narrow plates on the inside and outside, the whole when riveted together being known as a butt-joint. In this shell are two, three, or sometimes four smaller cylindrical furnaces which are riveted to the combustion-chamber, a semi-cylindrical box with flat top, front and back, in which the combustion takes place.

"You will notice that these furnaces are not straight, but consist of a wavy contour. In this particular case they are known as suspension furnaces. Some of them have a series of corrugations rolled into them, the object of both types being to give them sufficient strength to withstand the crushing strain brought upon them by the pressure of the steam. It is much easier for a cylindrical tank or figure to withstand an internal or bursting pressure than it is for it to withstand an external or collapsing pressure, hence all furnaces (in Scotch boilers) subjected to high pressures of steam on the outside must be corrugated in order that they will not collapse under the pressure.

"From the combustion chamber to the front head are a number of small tubes, usually from 2 inches to 4 inches in diameter, through which the hot gases pass from the furnaces to the uptake and thence to the smoke stack. It is from these tubes where the greater portion of the steam is formed, as they are usually from 1/16 to 1/8 inch in thickness, so that the heat from the gases is very readily transmitted to the water which surrounds them.

"As the heads of the boiler and the larger part of the combustion chambers are flat, they must be supported or braced at intervals in order that they may withstand the pressure brought upon them. Later on, I will teach you how to space these braces or stays, as they are termed, as that is a question which will be asked before you can get your licenses.

* Engineer-in-Chief, U. S. Revenue Cutter Service.

"In the furnaces of a Scotch boiler the grate bars are arranged at about the middle at the front end and slope slightly downwards toward the back end. The length of the grates is generally about 6 feet, as that is about as far as a good husky fireman can work his fires properly. Sometimes they are 5½ feet or 6½ feet long, but in general you will find them averaging 6 feet in length. The capacity of the fireman in this respect really regulates the length of most Scotch boilers. Hence you will find that single-ended boilers very seldom exceed 11 or 12 feet in length, while double-ended boilers are generally about 20 to 22 feet in length—a double-ended Scotch boiler being practically two single-ended Scotch boilers placed back to back and joined together. As I said before, there are a number of other types of shell boilers, but as most of them are obsolete we will not waste any time on them."

"What's obsleet?" inquired O'Rourke.

"'Obsolete' means old-fashioned, not up-to-date," replied the instructor.

"I see," replied O'Rourke; "it's something like that hat Schmidt wears when he goes to see his girl in Fishtown."

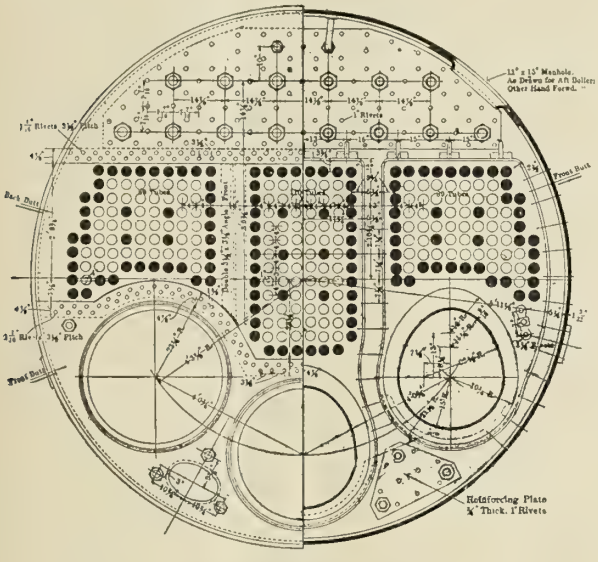


FIG. 1.—SCOTCH BOILER, END VIEW

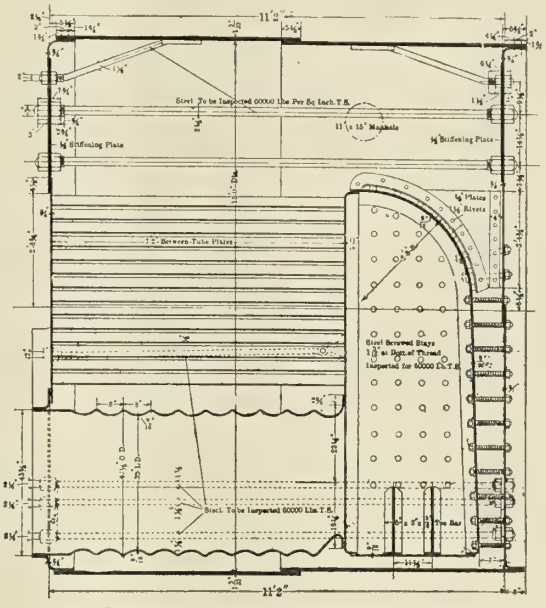


FIG. 2.—SCOTCH BOILER, LONGITUDINAL SECTION

"We will now look into the watertube boiler question a little. This type of boiler is having a hard time in overcoming the prejudice against it. At first they were used in swift steam launches and torpedo boats, on account of the great saving in weight as compared with shell boilers. Old-time engineers viewed them as a sort of a necessary evil in that respect and pitied the men who had to run them. The battle for supremacy in speed between the various nations finally led the more daring designers to use them in some swift cruisers and gunboats. As no great harm seemed to have come of this, the more progressive designers finally adopted this type of boiler for battleships. Old-timers shook their heads at this move and predicted dire disaster for the ships thus equipped. However, the results have been so satisfactory that to-day every new battleship throughout the world is fitted with watertube boilers, and they are giving the greatest satisfaction on account of their many superior qualities.

"O'Rourke, you of course know something about watertube boilers; how many classes of them do you think there are?"

"I don't know much about them myself," replied the young man, "but I heard a fellow out in the shipyard say to-day that there were two kinds, the macaroni and the spaghetti, whatever they mean."

"Ha! Ha!" laughed McAndrew. "I suppose he meant 'macaroni' boilers were those with large straight tubes, and 'spaghetti' as those having small, bent tubes. That is rather a good definition for the two main divisions of this class of boilers, but so far as different designs are concerned there must be two or three hundred, as every designer has his own ideas about getting up a watertube boiler. But these various kinds of boilers remind me of what they say about the fish in the waters around the Hawaiian Islands—there are 298 varieties, but they only use three of them to eat.

"In general, the main difference between Scotch and watertube boilers is that in the former the hot gases are inside the tubes and the water around the outside, while with the latter the water is inside the tubes and the gases around the outside.

"Watertube boilers usually consist of drums, headers and tubes, all inclosed in sheet metal casings. Usually there are one or two large drums on top and two or more smaller drums at the bottom, the tubes connecting the drums at the top and bottom. The feed water usually enters the boiler in the top drum, and is carried down to the lower drums through tubes or pipes known as down-flow tubes. Sometimes it flows down through the tubes themselves. In any event a rapid circulation is started up between the water in the lower and upper drums or headers. As the water passes up through the tubes, globules of steam are formed which, discharging into the upper drum with the water, are separated by baffle plates from the water and pass out through the dry pipe into the main steam pipe. The tubes in which the steam is formed are known as generating tubes to distinguish them from down-flow tubes when such are fitted to the boiler. Watertube boilers are usually rectangular or box-shaped, as the casing surrounds the tubes and the furnaces. In order to prevent the sheet metal casing from burning, it is usually lined with asbestos board and fire brick. Large tube boilers are those which have generating tubes 3, 4 or sometimes 5 inches in diameter. Boilers built of tubes 1 to 2 inches in diameter are classed as small tube or 'spaghetti' boilers, as O'Rourke's friend would say.

"Some engineers prefer one type and some the other, but if I had anything to say about fitting watertube boilers to a merchant vessel, the tubes would be as large as practicable and straight or nearly straight, so that they can be cleaned and examined."

"Why don't shipowners use watertube boilers in merchant vessels?" inquired Nelson.

"That's hard to answer," replied the Chief, "but I suppose it is for the same reason that many people refused to ride on the elevated road when it was first constructed in New York. They had been brought up to ride in corse cars on the streets: they knew they were safe and sure, and although they could ride faster on the elevated, they preferred the safety which they knew of, rather than to take a chance on the more modern means of transportation of which they were afraid. Such a trait of mankind is known as conservatism, and it is an excellent quality until it is carried to excess, when it becomes foolishness.

"The advantages watertube boilers have over Scotch boilers are many. The weight of a watertube boiler, with water, is just about one-half that of a Scotch boiler under the same conditions, thus giving that much more cargo-carrying capacity. Steam can be raised in a half hour, as compared to four to six hours for raising steam in a Scotch boiler. There is less danger from a serious explosion, as the parts of a watertube boiler liable to explode are much smaller than the great bulk of a Scotch boiler, under pressure.

"A watertube boiler need never wear out entirely, as the various parts can be renewed as necessity requires. When a Scotch boiler wears out, it must be renewed in its entirety, and generally at great expense on account of tearing away the decks and joiner work above the boiler space.

"Watertube boilers can be forced much harder, with safety, than Scotch boilers, as they are in a manner flexible and can stand severe usage which ordinarily starts a Scotch boiler leaking.

"One of the main features which would appeal most, just now, to you boys, is the matter of cleaning. In watertube boilers there are no back connections to sweep—a task which makes the life of an old-time chimney-sweep seem easy in comparison—no crown sheets to clean and sometimes scale, no cleaning of the inside of the boiler, where a man must go through contortions like a ferret to get at the heating surfaces. I doubt if any more disagreeable job could have been devised in the days of the Inquisition than that which befalls the lot of a marine fireman when it is boiler cleaning time on board a ship fitted with Scotch boilers. Surely there is nothing which more discourages men from going to sea. No wonder engineers hurry and get fat as soon as possible, so that it is a physical impossibility for them to get through a 12 by 15 inch manhole. If the stokers and coal passers could vote on the type of boiler to be used, I am afraid the Scotch boiler would soon get in the class with Schmidt's hat.

"The disadvantages claimed by opponents of watertube boilers are that it takes more skill to tend the feed on account of the smaller quantity of water in the watertube type. This, I am told, is more imaginary than real, although it must be admitted that a water tender must be onto his job at all times and keep his eyes on the glass. So, too, should a water tender with any other type of boiler, as that is a duty where day dreaming does not go. It is also claimed that strictly fresh water must be fed into watertube boilers at all times, but, as a matter of fact, that is so with a modern Scotch boiler if its efficiency is to be maintained. The care of marine boilers of any type is one of the most important duties on board ship. Carelessness on the part of anyone connected with the handling of boilers is not only dangerous to all on board, but frequently results in large repair bills and operating expenses. The most successful engineers are those who keep the boilers in good condition and operate them intelligently."

CHAPTER VII

Boiler Fittings

"How many fittings are there on a marine boiler?" inquired McAndrew.

"Four, sir," said Nelson.

"Only four, eh? Well, what are they?"

"The steam gage, gage glass, shovel and slice bar," replied Nelson.

"Oh! come off," said O'Rourke, "the shovel and slice bar are what the highbrows call the 'implements of your trade'—they're not fittings."

"Well, O'Rourke," said the teacher, "how many do you think there are?"

"Oh! at least half a dozen," replied he, "but for the life of me I can't think of their names just now."

"O'Rourke, you remind me of the fellow who, when falling off the water wagon, paused in the act of taking a drink and said, 'There are a dozen good reasons why I shouldn't drink this whiskey, but for the life of me I can't think of one of them now'—and then he took the drink. I don't think you have tried very hard to think of the necessary fittings on a boiler, but, at any rate, I'll remind you of some of them.

"You all know of the safety valves, which are generally made in pairs and are bolted to the highest part of the boiler. The old-fashioned safety valves were of the ball-and-lever type, but they are not used to any great extent these days, as they are poorly adapted for high pressures, or in fact for use on shipboard at all. One of the most important duties about the fireroom is to see that the so-called easing gear for lifting the safety valves off their seats is kept well oiled and in good working condition. At least every other day the valve should be lifted off its seat for an instant to see if the springs are working well. It might be necessary to open the safety valves in a hurry some day, and if the gear is not kept in good condition they would fail at the critical moment.

"The stop valves on boilers are very important fittings, as they control the passage of the steam to the engines. On every boiler you will find a large valve known as the main stop valve, and a smaller one, the auxiliary stop valve. These valves, too, should have their stems lubricated and kept in such condition that they can be worked easily. In this connection I want to warn you young men against opening a stop valve on a boiler suddenly—many a good man has gone to Kingdom Come by not bearing that in mind. You must remember that a sudden release of steam often causes large gulps of water to be carried with the steam through the valve and into the steam pipe, where a water hammer is instantly formed and often with the result of bursting the pipe. Even if no water is carried out with the steam, the pipes are cold, and the sudden condensation results also in a water hammer. When you open a stop valve, just 'crack' it at the start—by that I mean to turn the handwheel a mere trifle until you can hear the steam hissing through the slight opening. Then wait until you can count at least 200 before you give it another slight turn."

"It's too hot up there to be counting very much," interjected O'Rourke.

"Yes, but it isn't nearly so hot up there as the place you might go to if you opened the valve suddenly," said McAndrew.

"We have seen how to get the steam out of a boiler, but after all it is of even greater importance to get the water into it, for if you fail to keep the water flowing into a boiler under steam, there would soon be something doing.

"Schmidt, do you know what a check valve is?"

"No, sir," replied he, "I don't know just what it is, but I know where it is, and I know that you open it to let the water in the boiler after you start the feed pump."

"That's something to know," continued McAndrew, "but like a certain brand of breakfast food, 'there's a reason for it.' A check valve is one which allows water to pass in only one direction—that is, from the pump to the boiler. It is made that way so that in case the feed pipe should burst, the scalding hot water and steam from the boiler would not rush out through the opening in the feed pipe."

"I'm on," said O'Rourke, "it's like a one-way ticket to

24176

Coney Island—you can get down there all right, but you can't get back if you blow in all your money."

"Recently all marine boilers were required to have two separate openings in the shell and two separate check valves, a main and an auxiliary, to regulate the admission of the feed water, so that if one gives out the other can be used. There is also a stop valve located between the check valve and the boiler shell, so that in case of accident to the check valve the stop valve can be closed and repairs made to the check. It pays to take every possible precaution in regard to such an important matter.

"After we have provided means for getting the water in and the steam out of a boiler, the next thing in importance is to have some way to ascertain the level or height of the water in the boiler. Here, too, every precaution must be taken, for it is a very serious matter. You all have seen the gage glasses and how careful the water tenders are to watch the level of the water in them. The gage glass is, therefore, the most important of the means employed for determining the water level. As a further precaution, there are four gage cocks usually fitted on the side or in the front of the boilers at about the desired water level. I must confess that it is very difficult for anyone, except a locomotive engineer, to tell exactly the water level by means of these cocks. It takes a trained eye and a trained ear to distinguish between the steam and water when a ship is rolling. The locomotive engineer has to depend on gage cocks almost entirely, as it is impracticable to fit gage glasses on a locomotive. On board ship the men rely almost entirely on the gage glass, so they do not get much practice with the try cocks. I would rather take my chances by having two gage glasses fitted, as it is almost certain that both glasses will never be broken or out of order at the same time."

(To be continued.)

British Battleship Benbow

The British battleship *Benbow,* which is now under construction at the naval construction works of the Messrs. Beardmore, of Glasgow, is one of the four armored vessels of the 1912 programme. Her dimensions are as follows:

Length between perpendiculars	580 feet.
Beam	89 feet 6 inches.
Mean load draft	27 feet 6 inches.
Displacement at load draft	24,000 tons.
Designed power of turbines	33,000 S. H. P.
Designed speed	22 knots.
Coal capacity	3,000 tons

Armament—Ten 13.5-inch guns and sixteen 6-inch guns.

The ship is 90 feet longer, has 7 feet 6 inches more beam, 1 foot greater draft and 6,000 tons greater displacement than the *Dreadnought.*

The main propelling machinery consists of two sets of Parsons steam turbines designed for 33,000 shaft horsepower. Each set consists of one high-pressure ahead and one high-pressure astern, and one low-pressure ahead and astern combined turbine. The turbines are arranged in three watertight compartments; one high-pressure ahead and one high-pressure astern, fitted to the same shaft, are arranged in the outer compartments and both low-pressure in the center compartment.

All of the turbines are controlled from the center engine room and connections are arranged so that, in the event of either or both side engine rooms being disabled, the ship can be driven with only the low-pressure turbines. There are four shafts, each fitted with a solid bronze propeller.

The main condensers are arranged in the center engine room, one for each set of turbines. They are of the Weir Uniflux type, and the large circulating pumps of Allen's centrifugal type are fitted to each. Two of Weir's Dual air pumps are also fitted to each condenser.

A complete system of forced lubrication has been installed for the supply of oil to the turbine and shaft bearing blocks. Powerful overhead travelers are arranged on girders on the underside of the lower deck, over each shaft, for lifting the upper half of turbine casings and the turbine rotors when necessary.

The usual auxiliary machinery is provided. Powerful steering engines in duplicate are arranged in the engine room, connected by means of shafting and gearing to the rudder heads and controlled from the steering positions by telemotor gear. An auxiliary condenser, evaporator and distilling plant feed pumps, fire and bilge pumps, oil fuel pumps, and forced draft fans are also fitted. There are also air compressors for torpedo service, and hydraulic pumping engines for the gun machinery and the hydraulic boat hoists. A steam-driven capstan and windlass is fitted forward, and several electric coal-hoisting winches are placed on deck.

Steam is supplied by an installation of eighteen Babcock & Wilcox boilers. They are of the latest type, designed for burning coal and oil fuel, and are arranged in three watertight compartments.

As regards the armor of the ship, it extends for practically the full length of the hull, being 11 inches thick from about 5 feet below the water line to near the upper deck, while the top strake of armor is 9 inches thick. Toward the stem and stern the thickness is reduced. Heavy armored bulkheads extend across the ship at the forward and after ends of the thick side armor, in order further to protect the barbettes, which are of 12-inch armor. The conning tower is also constructed of 12-inch armor.

Like all the previous dreadnoughts, the *Benbow* has a high forecastle, so that the forward 13.5-inch guns are mounted at a great elevation. All the guns are mounted in pairs on the center line of the ship, this arrangement giving a broadside fire of ten guns, an ahead fire of four guns and a fire astern of four guns. The anti-torpedo boat armament of the *Benbow* is a novel feature. There are sixteen guns, as in all the earlier super-dreadnoughts, but they are of 6 inches instead of 4 inches caliber. The adoption of the 6-inch gun is a reversion to the idea of secondary armaments. The ship has three submerged torpedo tubes, each capable of firing 21-inch torpedoes, and to protect her from torpedo attack there are torpedo defense nets all fore and aft.

The propeller shafting passes through the ship's hull, and each shaft is carried in stern struts of the A type. The two rudders are of the balanced form, unsupported outside of the hull, the weight of each rudder being carried on the lower deck.

In outward appearance the *Benbow* resembles the *Dreadnought,* having two stacks and one mast. The sister ships are the *Iron Duke,* laid down at Portsmouth dockyard, the *Marlborough* at Devonport, and the *Delhi* at Vicker's yard, Barrow.

New York Motor Boat Show

The ninth annual New York Motor Boat Show was held in the Madison Square Garden, Feb. 15 to 22. The exhibits included nearly every type of motor boat from small powered cruisers to large cruisers and the speediest racing craft, marine motors of practically every type on the market, from the smallest single-cylinder engines to the highest powered heavy-duty engines, and the host of accessories which go to make up the equipment of a successful motor boat. Marine engines for motor boats never have, and probably never will, approach a recognized standard of design, as has been the case with the steam engine, and for this reason the annual Motor Boat Show is of particular value, as it gives an opportunity to study at first hand the developments and improvements which are continually being made in design.

Letters from Practical Marine Engineers

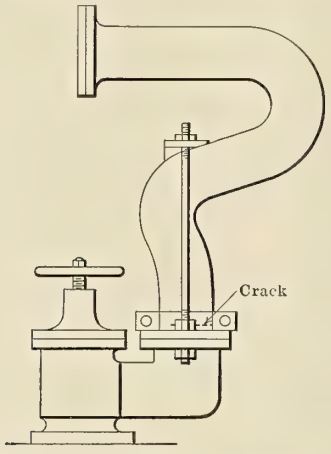
Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

A Varied Experience

The following is an interesting and, I venture to say, instructive, incident that befell me some years ago while a member of the staff of engineers on board the steamer *Wearside* on a memorable and never-to-be-forgotten voyage from Rotterdam to Sandy Hook for orders.

To begin with, we were running light, and as it was the month of February, we knew from past experience that the Atlantic at that time of the year was in anything but its best mood, and especially to a ship which was for all the world like a cork upon the water.

Though I have crossed the "herring pond" many times since, not only in a first-class cargo boat, but also in monsters like the *Lusitania,* I have never encountered a voyage nor



METHOD OF REPAIRING CRACKED STEAM PIPE

seen seas to equal the occasion of which I write. I often look back with wonder that we ever reached the good old Hook at all.

Well, the weather showed us in the first few hours after we got clear of the land what we were to expect, and those of us who were inclined to think lightly of it were very forcibly reminded by the roar at almost regular intervals from the engine room, when the engines were engaged in trying to pass each other, that the ship would have been a good substitute for a hydro-aeroplane. First, she would roll hard to starboard and wallow in the trough of the sea, then she would swing hard aport until one began to wonder whether she would ever right herself. She never seemed to tire of this, and would pitch her old stern out of the water between times until it seemed to those on board as though she were taking a header to the bottom. Of course it was hard work cooking in the galley, and we all pitied the poor cook, but were inclined to be tickled over the idea of his having to grip pots and pans in a wild endeavor to keep them on the stove until the "Messroom" capsized our joint over the side, in an ill-fated trip from the galley, and then we had to be contented with a tin of "Harriet Lane" for our dinner.

Meanwhile the wind was shrieking like a thousand fiends and on all sides nothing could be seen but mountains of water. We had a solid eight days of this, and were told the cheering news that we were only 180 miles from the English Channel. Then things began to get serious, as our coal was steadily being consumed and little or no headway was being made. Then it was that the chief engineer gave one of those puzzling (to landsmen) orders, "Go slow to save coal." We were accordingly slowed down to little more than quarter speed. Even at this rate the engines still continued to roar out their challenge to the sea, and we engineers hardly dared leave the throttle for fear of a smash-up. But instead of letting up things got worse, and finally came the order from the bridge, "Stop."

It was useless battling against such seas, and the old man ordered us to stop in the hope that the weather would moderate. The wind did moderate a little, but the sea got worse, as it always does when the wind drops. Anyhow, as we could not stay there forever, a fresh start was made some few hours afterwards. It was my watch below as we started, and we had hardly been under way more than a couple of hours when a heavy pounding of the feed pumps and continual discharge from the hot well overflow, coupled with the heavy lifting of the feed pump relief valves, convinced me instantly that we were up against it. I immediately put the auxiliary feed pumps in service to deal with the condensed water, and the chief was summoned and a halt called.

We examined the port feed pump, which was of the plunger type so common to marine engines, and we found, on examination that the suction valve was loose, and lifting with the valve at each stroke. We had no spare ones, so a joint was made of red lead and marline and the seat jammed back into its place. We then drilled a 5/8-inch tapping hole through the casting of the pump chamber, and fitted a screw bolt to set up on the seat, thus preventing effectually, it proved, any further annoyance from this source.

Once more a start was made, much to the relief of the engineers, as it is no joke working under such trying conditions, as with the main engines stopped the leaks from various causes soon filled the bilges, and not a very pleasant time was afterwards spent clearing the "strum" and "mud boxes" of ashes, grease, etc., which, with the vessel rolling and pitching as she was, got washed off the tank top down into the bilges, thus choking the bilge pumps.

We were doubled up now on six-hour watches, the chief and myself and the first and second assistants. It was some four days after the incident just related, about 1.30 A. M., exactly one and a half hours after the chief and I had gone above for a much-needed rest. We carried no "greasers" and the engineers were required to do their own oiling, and those of my readers who have had any experience of clinging to a handrail on an open front type of engine with one hand, holding a duck lamp in the same hand and an oil can in the other, waiting for the ship to roll, so that you can hit the oil cups and incidentally get some drops of scalding water down the back of your ear from a leaky piston gland, will know what I mean when I say "a much needed rest" after six hours of it.

To continue. I was asleep, it seemed like only five minutes, when the first assistant burst into my berth with "Hey! get up and come down at once! Hurry up!" Needless to say, I got up in jig time, wondering what was wrong, and went down below. Somehow I did not feel surprised to find the engines slowly turning the centers, but I was surprised and, I may add, a good deal nervous, when I was told "It's the center main steam pipe."

It was only too true. Worn out by the continual vibration

due to the incessant racing of the engines, the good old copper main steam pipe, ¼ inch thick, had given way under the strain, and the ominous hiss of escaping steam could be distinctly heard up on the boiler tops, while each race of the engines, though comparatively small now, literally jarred our nervous systems. We felt like men facing death at any moment, as the chief, who took a squint at the fracture from the door just ajar leading on to the top of the boilers, returned with the news that the pipe was cracked more than two-thirds of the circumference.

All fires were immediately banked, and we proceeded to the nerve-racking process of shutting the main stops on the boiler mountings, and of course in the immediate vicinity of the damaged pipe. It was accomplished at last after the saying privately by us all of a good many prayers, as of course we had to take spells owing to the stiffness of the valve, to say nothing of the heat, as it was not possible for one man to do the job, nor was it expected of him, and it takes a good deal of screwing up of courage to stand alongside an 8-inch steam pipe, knowing same to be cracked and liable to blow bodily off at any minute, and shut a valve down to, say, about 26 turns.

When the stops were shut, however, and the engines at rest, we breathed easier, though we knew we had a hot job before us. I have made a sketch of the way the chief decided to repair the pipe, which was roughly shaped like a question mark. The fact that the crack was very near the flange made patching no easy job. A clamp of ⅝-inch by 2-inch flat steel was made to fit the pipe and passed over the crack and as near the flange as the heads of the joint bolts would allow. This was screwed up as tightly as possible over an asbestos cloth joint, by means of the two ¾-inch bolts in the lugs of the clamp. This arrangement was to take care of the steam which would escape from the crack.

Now, to prevent the pipe from blowing off in the event of the fracture extending right around the pipe was the next step. To meet this emergency, two bolts were taken out of the joint and an old fire rake handle was cut into two pieces, each 3 feet long, and screwed at each end about 9 inches. These, with nuts to fit a ⅞-inch rod, were substituted for the bolts just removed, and a bridge piece of flat stuff was made to cross over the bend in the pipe and engage with the bolts. The whole was then screwed up tightly.

This arrangement lasted very well for some time, but the bad weather, with consequent racing of the engines, continued, and finally a halt was made and the pipe taken off bodily. Two ¾-inch steel blanks were made to fit the flanges on the boiler mounting and three-way tee. The fires of both the center and starboard boilers were drawn and the boilers blown down, and by stripping the boiler deck steam stop valve on the wing boiler, and leaving out the valve, which was of the non-return type, and the center boiler deck stop valve being left open, we thus established connection between all three boilers again, and did not leave the center boiler idle.

While this job was in progress we were hove to, at the mercy of wind and wave, and it must have been this fact which prompted the "Master" of that fine steamer *Kaiser Wilhelm der Grosse* to ask us if all was well as she passed, which she did in a few minutes, so to speak, though the sea was running very high. We replied, "Yes! all safe," and when, half an hour afterwards, all one could see of her was the smoke trailing away on the horizon, we felt as though we had lost a friend.

We had to make St. Michaels, in the Western Islands, for more coal, which we just managed, and exactly thirty-one days six hours from leaving Rotterdam, we crawled up to Sandy Hook, a very battered and rusty tramp, but containing in her engine room four tired but thankful engineers.

Perth Amboy, N. J.

C. Carl Weddell.

Why the Cost of Life-Saving Appliances on American Ships has Increased

During the last year the matter of life-saving appliances has been most thoroughly considered by the Supervising Board of Inspectors, and many new regulations have been made by it with the view of providing better means of safety at sea.

The changes made have, there is no doubt, resulted in far more efficient apparatus for life saving being fitted in all ships. The new regulations have, however, materially increased the cost of such appliances, and shipowners are fairly staggered by such advances. It is my purpose to show that these advances are not due to an arbitrary advance by the builders of apparatus, but simply to the fact that the new regulations demand certain changes. For instance, one size of life raft was, under the laws of the Board of Supervisors, allowed to carry 28 persons; the rules to-day allow only 15 persons to the same size of raft. Here, at once, is an advance of almost 100 percent in cost per person. To make it clear, under the old rule this raft would cost the shipowner $6.08 (£1 5s. 4d.) per person, while to-day it would cost him $11.33 (£2 7s. 2½d.) per person. Here there is no advance in price by the raft builders.

There has been a steady advance in the material used in raft building, and corresponding advance in price, which on the average would bring it up to $12 (£2 10s.) per person. No fault can be found, if a moment's thought is given, with the builders, and it is hardly fair to say that the Board of Supervisors has arbitrarily made the reduction of persons carried, as they are all painstaking gentlemen who have gone into the matter of safety with the greatest care and arrived at their conclusions after mature reflection and due consideration of real life-saving appliances.

The great height of the deck of modern ships from the water has precluded, in most cases, putting a lifeboat into the water and then filling it with passengers. It therefore became necessary to build a boat able to stand its load of persons while cradled in its chocks or swung out, and a steel keel is now used to give the required stiffness to stand this load.

In the metallic lifeboat, under the old rules, two watertight air tanks were demanded of certain capacities. These were built into the bow and stern, the skin of the boat forming two sides of the tanks with a deck and vertical bulkhead forming the other two, the air capacity being about 38 cubic feet, 62 cubic feet being required under the new law. To-day the same size of boat must be fitted with ten independent air tanks. Now, what does this mean? First, a boat which can withstand far more damage without sinking, as it is quite impossible to have more than one, or at most two, of the air tanks punctured at the same time—in fact, it seems to me that they could not be punctured under any condition, but only dented without materially injuring them as a buoyancy medium. On the other hand, the following will show where it affects the builder and shipowner:

In one size of lifeboat the old system of air tank required 90 pounds of galvanized sheet metal and two connections for testing. The new tanks require 384 pounds of material and ten air test connections, with extra expenditure in time and material to secure the tanks in the lifeboat.

All the fittings about lifeboats have been made heavier, and the material in some cases changed from malleable iron castings to steel forgings. Again, to the shipowner the requirement of accommodation for all on board, either on life rafts or in lifeboats, results in an enormous number of these appliances being supplied, or a very great reduction in carrying capacity of passengers. In one case there is a seriously increased investment, and in the other a serious decrease in earning capacity.

Shipowners have the erroneous idea that this advance goes into the pockets of the builders. It is very plain to see that

TABLE I.—DIFFERENT LIFEBOAT ARRANGEMENTS WITH WELIN QUADRANT DAVIT-LUNDIN DECKED LIFEBOAT—STANDARD LIFEBOAT

Arrangement.	I. 1—28-Foot Standard Lifeboat, "A" Davits.	II. 2—26-Foot Lundin Lifeboats, Nested, "A" Davits.	III. 1—26-Foot Standard Lifeboat, "B" Davits.	IV. 2—24-Foot Lundin Lifeboats, Nested. "B" Davits.	V. 1—26-Foot Standard and 2—24-Foot Lundin Lifeboats, "DA³" Davits.	VI. 4—24-Foot Lundin Lifeboats, Nested, "DA³" Davits.
Persons	50	100	40	80	120	160
Deck space, including davits, square feet	272	264	234	225	468	495
Deck space per person, square feet	5.44	2.64	5.85	2.8	3.9	3.1
Length of deck	32′ 6″	30′ 6″	30′ 6″	28′ 2″	30′ 2″	29′ 2″
Total weight, including chocks, pounds	7,800	11,900	6,350	9,750	13,300	16,700
Weight per person	156	119	160	122	112	104
Weight per square foot of deck	29	45	27	43.5	28.5	33.5
Total cost, including chock fitting	$1,319	$2,845	$1,171	$2,437	$3,283	$4,549
Cost per person	$26.40	$28.45	$29.30	$30.50	$27.25	$28.30

TABLE II.—COMPARATIVE TABLE.

Arrangement.	Weight per Person.	Space per Person.	Length of Deck per Person.	Cost per Person.
II:I	76%, gain 24%	48½%, gain 51½%	47%, gain 53%	107½%, loss 7½%
IV:III	76%, " 24%	47½%, " 52½%	47%, " 53%	104%, " 4%
V:III	70%, " 30%	66⅔%, " 33⅓%	33%, " 67%	93%, gain 7%
VI:III	65%, " 35%	53%, " 47%	24%, " 76%	96½%, " 3½%

ten independent air tanks requiring such an advance in materials must require a very great advance in the wages paid for their construction. Each tank has to be formed, lock-seamed and soldered, furnished with test connections, made fast, and a plate stating its cubic capacity soldered on it, and, further, means must be provided to suspend and secure these tanks and place them in position. All this advance in cost, save a very small increment to meet additional overhead charges, goes into the pockets of the workmen—in fact, those who benefit most by the new rules are the workmen.

Of course the traveler is better protected, his safety is made greater; this being the fact, it seems to me only fair that those who run ships and steamers have a right to make an advance in their passenger rates. It is all very well to say that these life-saving appliances should have been provided long ago, and that now that the law requires real safety no advance should be made because such is provided. The record of the past shows beyond all question that American ships in foreign trade have not been able to make money under the old laws, and the proof is that they have faded from the "face of the deep and are no more known." With only a slight increase in passenger rates the additional investment required in installing adequate life-saving appliances for all on board as specified by the Board of Supervising Inspectors could easily be defrayed without the necessity of cutting down the number of passengers carried at the former rates.

Lifeboats were sold in the United States up till last year at one-quarter less cost than in other countries. As a matter of fact, this was the sole case where American equipment of any kind was disposed of at a figure below foreign prices. The reason for this was that the lifeboats, as then made, were not as well constructed as those built abroad. In the effort to keep the American merchant marine on the water at all, the cheapest possible equipment was demanded, and the laws did not demand a really first-class product. To-day it requires a boat construction which, while high in cost, is of a vastly higher grade. It is rather strange to hear it argued that the new laws are all unnecessary for American ships, as they are very safe and always within short distances of help on shore, yet the people who so argue admit that there are cases where lifeboats are called upon to do the work that their name implies, but, when it comes down to "brass tacks," the real objection seems to be the increased cost only. Now it should be remembered that when a lifeboat is wanted the very best obtainable is none too good, and no practical sailor will gainsay this. The man who has to handle an appliance in which he does not feel absolute confidence is not at ease, nor is he able to do his best, and none but those who "go down to the sea in ships" can understand the feeling that overtakes a man amidst the rushing waters, waves and howling winds if he doubts the tools with which he has to work. It took a terrible disaster to impress the world with the condition which existed as to lifeboats and means of handling them, and the present laws which resulted from that disaster have made for far greater safety at sea, and the only objection that I have heard raised against what is now demanded is the increased cost of life-saving appliances.

In Table I is shown, at a glance, a most interesting exposition. Here the cost of a 28-foot standard lifeboat, together with its required Welin davits, including chock fittings, comes to $1,319 (£270), or a cost per person of $26.40 (£5.42). This size of boat accommodates 50 persons, taking 272 square feet of deck space, or a deck space of 5.44 square feet per person. The length for boat and davits is 32 feet 6 inches, a total weight of 7,800 pounds being required, which gives a weight per person of 156 pounds, all included. In this case the deck has to carry 29 pounds per square foot. It will be noticed that nested Lundin decked lifeboats give the least weight per person, and the least required deck space. The standard lifeboats used single require about twice as much deck space. Table II gives an interesting comparison of the different arrangement of boats and davits tabulated in Table I.

New York. W. D. Forbes.

A Shop Kink

The threaded seat of a large stop valve connected with a battery of boilers had become loose on account of the threads being worn away. To remove the valve from the boiler meant the expenditure of considerable time and work, as the bolts had become cemented by rust. Considerably more time would be required to take the valve down, haul it to the machine shop, set it up in a lathe, rebore and cut it, so it was decided to do the job with the valve in place. A piece of iron was obtained and holes were drilled to bolt it to the flange on the valve body. A hole two inches in diameter was then bored and threaded twelve threads per inch. With a piece of round iron a boring bar was rigged up with a hole in the end for the cutter, which was secured by set screws. A square-nosed tool was used to remove the old worn threads. The hole was made true, and then a V-thread cutter was put in for the first cut. For the next cut the cutter was removed and the bar returned to the starting point. The cutter was then inserted and another cut was taken. After the operation had been repeated several times a good thread was secured.

The new seat was turned and threaded to a good fit, and all was done in a comporatively short time without disturbing the valve.

Lathe Hand.

The Possibilities of the Marine Oil Engine

An article by Mr. Lucas on the producer gas engine as a solution of the problem of marine propulsion, which came out in 1903, together with a similar article by Mr. Nixon in *Cosmopolitan,* was the inspiration for a communication which was published in the December, 1904, number of the Marine Engineering. In that communication I told what could be accomplished by the use of the heavy oil engine, and reference to that article will show that my description reads very much like the articles we are now reading about pioneer Diesel-engined ocean vessels.

I differ from Mr. Lucas now as then, but in a different degree. It may be interesting to compare my ideas with those of Mr. Lucas as they came out in the February, 1913, issue of International Marine Engineering.

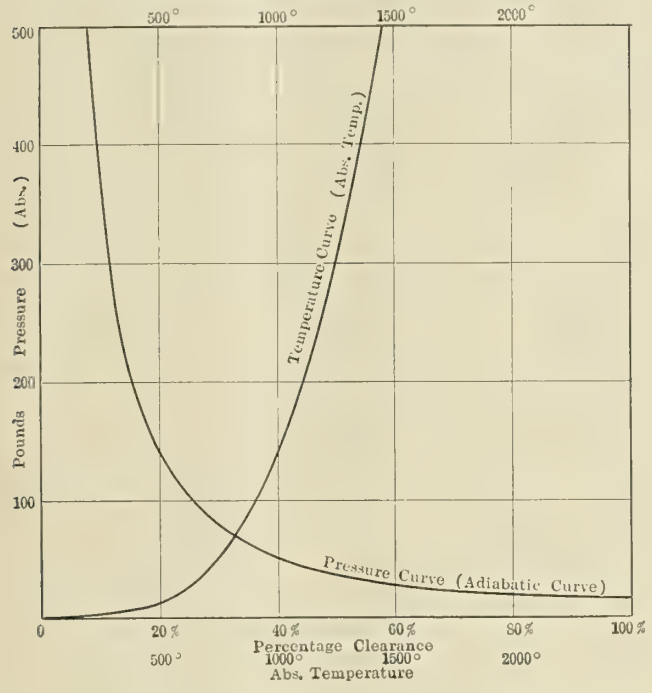


FIG. 1

The advantages are:

1. Small space. I brought this point up in connection with the gas producer type of engine. The producer will be very near the size of a steam boiler, if not larger.

2. The matter of weight is not in the weight of the engine. If the oil engine plant is as heavy as the steam plant it still has a very great saving in fuel weight. A pound of coal has 14,500 B. t. u. against the 19,500 B. t. u. for oil. The efficiency of the oil engine is about 25 percent against the 12 percent for the steam plant. This means that one ton of coal can be displaced by 850 pounds of oil.

3. The rapidity with which full power can be developed when the engine is running light.

The disadvantages are:

1. The absence of steam for the auxiliaries and for heating purposes. The employment of gasoline (petrol) is not a disadvantage, for gasoline (petrol) should not be used in the oil engine. It can be used if it is on board and the regular fuel supply is exhausted.

In my early study of the heavy oil engine I wondered why Dr. Diesel did not patent the method of procuring combustion by means of the heat of compression. I found that Beau de Rochas discovered this method or described it in 1862. The explosive method I do not think can be used in the oil engine. To use a spark there must be a gaseous mixture. This means a gas must first be made of the fuel, which then converts the engine into a gas engine.

In vaporizing the fuel, as stated by Mr. Lucas, two classes were mentioned: (1) The hot chamber or shield vaporizing type; (2) mechanically atomizing type.

Personally I have no use for the hot chamber type. That has been worked out by several engineering firms in the last twenty years. I should be afraid of a layer of soot forming on the hot surface which might interfere with the action of the surface. Second, with this method the combustion must spread from a certain locality. This will mean a slower combustion.

In regard to the mechanical atomizer, it does not help you.

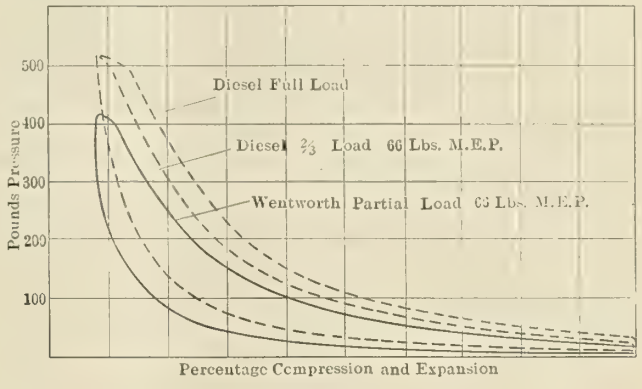


FIG. 2

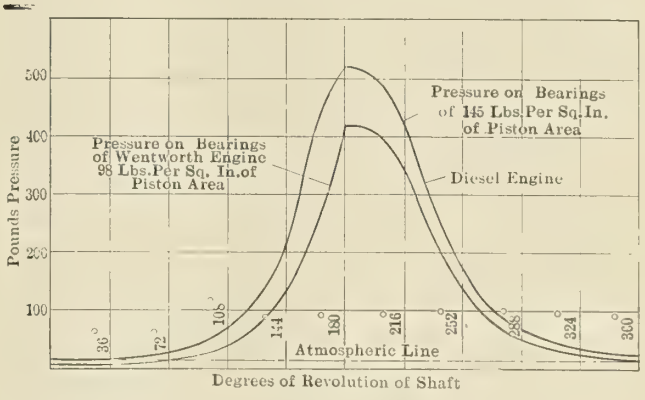


FIG. 3

When you have your spray in the engine you must then ignite it. The ignition of a large engine must come from the temperature of the air. This can be obtained in two ways:

1. By the de Rochas method of compression of cold air to a point where the ignition temperature of the fuel will be reached.

2. By the Wentworth method, where this temperature will be arrived at by a combination of the temperature of compression added to a certain degree of preheat. So far as I can find, this method had never been proposed prior to the time I developed the design enough to submit this to the U. S. Patent Office.

Fig. 1 will enable anyone to figure out what this preheat will do. If it is assumed that the incoming air has a temperature of 60 degrees Fahrenheit (520 degrees Fahrenheit absolute) and the engine is to ignite at 250 pounds pressure, it can be seen from the curve that 500 pounds pressure will give a temperature of 1,450 degrees Fahrenheit absolute. At 250 pounds the temperature of compression is 1,200 degrees Fahrenheit absolute. The needed increase in temperature is 17 percent. Seventeen percent of 520 degrees Fahrenheit is 90 degrees preheat. Ninety degrees added to 60 degrees will

mean that if the air is preheated to a temperature of 150 degrees Fahrenheit, or 610 degrees Fahrenheit absolute, the same temperature can be obtained at 250 pounds pressure that the so-called Diesel engine gets at 500 pounds pressure.

Mr. Lucas has shown us diagrams for the ahead and backing operations. I take exceptions to his diagrams. Perhaps I read his diagrams more closely than he intended them to be read. He has given us degrees, and so I think I am right to infer that he intended exactly what is shown. The fuel injection is shown as 22½ degrees. The injection begins exactly at dead point. Now I believe in following the beaten paths unless there is a good and sufficient reason for leaving them. We find that advancing the spark in the gasoline (petrol) engine gives good results. The explosion in the gasoline (petrol) engine is more rapid than the combustion in the heavy oil engine. You can get no combustion in the oil engine till the fuel is fed in, and then it can only burn as fast as it is injected. You may judge that I hold no brief from the Diesel interests, so I cannot speak for the reason why they do things. I judge, however, that the fuel is not fed in ahead of the dead point more because they already have all the pressure they care to handle in the engine. As a result, they are willing to sacrifice something of the efficiency of the engine in order to save on the wear and tear of the engine. In my experimental engine I have increased the pressure of compression from 440 to an explosion pressure of 740 pounds by the injection of the fuel. There is a loss caused by this retarding of the injection, and I am under the impression that even the Diesel, with its high pressure of compression, can and does advance the injection a few degrees ahead of the dead point without any serious increase of pressure. If the fuel injection is to be continued for 22½ degrees rotation of the cam shaft, that would mean that fuel would be fed for one-fourth of the working stroke. This is approximately what Mr. Lucas's illustration tells us. The angularity of the connecting rod will effect this by adding a little to the one-fourth of a stroke. The efficiency of an engine with such a late and prolonged fuel injection would be to approach the method of the Lanior engine. This engine was the first gas engine put on the market. The mixture was drawn in for one-half stroke and a spark passed through the mixture when the admission valve closed and expansion of the exploded charge took place on the last half of the stroke. Mr. Lucas, if he reverses the operation shown in his diagram, would better the Lanior efficiency by a good deal, but still be far short of what it should be. I have ignored one serious blunder in his diagrams, which probably is simply an oversight. He reverses all the operations of the engine. For instance, there will be an exhaust stroke and then combustion, and then the injection of the fuel followed by compression and then admission.

Mr. Lucas has told us of the possibilities of the marine oil engine. Why did he not tell us of the possibilities of the engine under light loads. Take the extreme case, an engine in a naval vessel. The present custom is to run the vessel at cruising speed. In talking with engineers I have been given to understand that this is on account of the personnel equation. I do not believe it. I feel that if mechanical stokers could be installed so that the vessels could be run at full speed without any extra wear and tear on the fireroom force, I still hold that the naval regulations would require a moderate speed for ordinary cruising and only occasional high speed runs in order to see that the machinery was kept at full efficiency.

For naval work the Wentworth engine would take in a full stroke of air at full load and the card would not vary much from the conventional so-called Diesel type. At partial load the Diesel still takes in the full allowance of air for no reason at all except to get the required temperature of compression. The Wentworth engine will cut down its air supply to fit the needs of the service. It can do this by means of preheat. Fig. 2 shows how this will work out. The Wentworth card is so drawn that it has the same load M. E. P. that the Diesel partial load does. Fig. 3 shows the effect of this upon the bearings of the engine. I assume that the main friction loss in an engine of this type or any other type is in the bearings. If this is so, the Wentworth and Diesel engine running under the same load will have a vastly different frictional loss. In the Diesel the effect on the bearings will be that which would be caused by an M. E. P. of 145 pounds per square inch on the piston, during the suction and working strokes, while the Wentworth engine under the same power will have an effect as caused by 98 pounds per square inch in the cylinder.

This is shown by plotting the pressures for each 36 degrees angle of revolution of the crank shaft. To get this result in the Wentworth engine, about two-thirds of a cylinder of air is taken into the engine and then a vacuum is created in the cylinder by the rest of the suction stroke. If the engine cylinder is 40 inches in diameter, the thermodynamic effect is that which you would get if you could compress the air in a cylinder of 34 inches diameter and expand the gases in a cylinder of 40 inches diameter. This means that for naval work and in other similar cases where full speed is not required at all times it is possible to practically compound the oil engine.

Quincy, Mass. John F. Wentworth.

Heroic Method of Shutting Off the Bottom Blow

While running on a tug boat it became necessary to take the following heroic method of shutting off the bottom blow. While this method worked out satisfactorily in this case, it is by no means recommended as one of the best ways of closing the bottom blow.

The tug was towing three barges of sand against a stiff current with about all the power that could be developed. The boilers were priming to the extent that what might have been gained was lost by the constant throttling of the engine on account of the priming. Finally it was thought that a bottom blow of a couple of inches might steady the water in the boilers and lessen the priming.

The bottom blow consisted of a 1½-inch copper pipe with a plug cock which went directly overboard with no intermediate valve except a non-return check. A man was stationed at the valve to close it when the signal was given.

It frequently happens, as in this case, that these valves are located in inconvenient places and are quite difficult to reach, so when the signal for closing the valve was given, the valve would not close and the man's frantic endeavors were of no avail. Meanwhile the boiler had been blown down to within one inch of the bottom of the glass, consequently there was no time to spare, and it seemed that we should have to haul the fires and remain stalled in the most difficult part of the river. However, an idea came into my head which I hope will never have to come again, and picking up a square block of hard wood that lay in the fireroom and a coal maul I threw them over the guards and then went after them, shouting to the water tender to put all feed pumps on the boiler with the bottom blow open. I shoved the block along the bilges under the bottom blow pipe, which ran in a slanting position till I had the block fitted snugly between the bilges and the pipe. I sent a man out from under the boiler and made things as easy as possible for myself to get out if I had to run for it, then taking the coal maul I smashed the pipe down flat on the block and succeeded in closing the pipe together so that if it leaked any it was very little, and at least not enough to prevent us from finishing the trip successfully. When the valve was removed it was found that a piece of wood had floated into the valve and stuck there, so that it had prevented the valve from being moved one way or the other. A Reader.

Marine Articles in the Engineering Press

The Cost of British and German Warships.—The recent publication of figures of the new German navy estimates affords a means for comparing the cost of the latest German and English warships. The facts brought out in this article clearly show that at the present time the capital ships of Germany are each costing from 10 to 15 percent more than the corresponding ships built in British yards. 1,250 words.—*Engineering,* Jan. 31.

The Triple Screw Channel Steamer Greenore.—The triple screw steamer *Greenore* delivered to the London & Northwestern Railway Company in July last for their Holyhead and Greenore service is the fourteenth vessel built by Messrs. Cammell, Laird & Co., Birkenhead, for the same owners, and is the first turbine steamer to be placed in the railway company's Holyhead service. The ship is 305 feet long between perpendiculars, 40 feet molded breadth, 23 feet 3 inches depth, molded to bridge deck. She is propelled by Parsons turbines constructed by Messrs. Cammell, Laird & Co., arranged on three shafts; the high-pressure turbine is on the center shaft with a low-pressure turbine on each of the wing shafts. The designed speed is 21 knots. Steam is furnished by five Babcock & Wilcox boilers. 3 illustrations. 700 words.—*The Shipbuilder,* February.

Quadruple Expansion Engines for the T. S. S. Macedonia.—The T. S. S. *Macedonia* of the National Steam Navigation Company, Ltd., of Greece, plies between Piraeus and New York. The vessel carries about 2,000 passengers and emigrants, and was constructed for a sea speed of 16 knots. The hull was built by Messrs. Sir Samuel Laing & Co., Ltd., of Sunderland, and the propelling machinery was supplied by Messrs. George Clark, Ltd., of Southwick Engine Works, Sunderland. The engines are of the four-crank quadruple expansion type, balanced on the Yarrow-Schlick-Tweedy system with cylinders 24 inches, 34½ inches, 49 inches and 71 inches diameter, with a stroke of 48 inches. The high and first intermediate-pressure cylinders are fitted with piston valves and the second intermediate and low-pressure cylinders are fitted with double ported slide valves. The engines are supplied with steam from five single-ended forced draft boilers, 17 feet mean diameter and 12 feet long, working at a pressure of 220 pounds per square inch. 2 illustrations. 400 words.—*Engineering,* Jan. 10.

Typical Ships. I. An Up-to-Date Cargo Ship.—The ship chosen as an example of an up-to-date cargo ship is the *Boeton,* built by the Central Marine Engine Works, of West Hartlepool, for the Netherland Steamship Company, of Amsterdam. She is 412 feet 6 inches long by 53 feet 6 inches beam and 29 feet 7½ inches depth. She has a gross tonnage of about 1,300, and is driven at a speed of about 13 knots by a triple expansion engine, having cylinders 28 inches, 46 inches and 77 inches diameter by 48 inches stroke, developing 3,700 indicated horsepower at 78 revolutions per minute, being supplied with steam at 180 pounds pressure by four single-ended three-furnace steel boilers operated under Howden's forced draft system. The ship is of the double decked type with a complete shelter deck and the striking point about the general arrangement lies in the fact that the whole of the crew is berthed amidships abreast of the engine casing instead of forward. While no particular original features are claimed for this vessel, or its machinery, yet it is taken as representing an economical type of cargo steamer, well built and successful in operation. While only a comparatively small number of auxiliaries are to be found in a ship of this type, yet the part they play in aiding the general economy of the machinery installation is important, as the net results in this case works out with a fuel consumption of 1.25 pounds per indicated horsepower per hour for all purposes and not for the main engines alone. Both the propelling and auxiliary machinery are described at some length. 18 illustrations. 5,000 words.—*The Engineer,* Jan. 24 and 31.

The Japanese Battleships Kawachi and Settsu.—The *Kawachi* and *Settsu* represent Japan's first attempt at dreadnought construction, the preceding battleships, the *Aki* and *Satsuma,* armed with four 12-inch and twelve 10-inch guns being now regarded as enlarged ships of the *Lord Nelson* class, although at one time they were included in tables of dreadnoughts along with the French *Dantons.* The *Kawachi* and *Settsu* are 479 feet long on the waterline, 86 feet beam, and at a draft of 28¼ feet have a displacement of 20,750 tons. They are driven by turbines of 25,500 horsepower, designed to give the ships a speed of 20.5 knots. The turbines on the *Kawachi* are of the Curtis type arranged on three shafts. On the *Settsu* there is a Parsons installation with four screws. The boilers are of the standard Miyabara type, the fuel capacity being 900 tons normal and 2,500 tons maximum. The main armament of these vessels consists of twelve 12-inch guns located in six turrets, one forward, one aft and two on each broadside, an arrangement which is severely criticised as inefficient and extravagant. There are ten 6-inch and ten 4.7-inch guns, besides five 18-inch submerged torpedo tubes. The main belt of armor extends from bow to stern and is 12 inches thick amidships and 5 inches thick at the extremities. The main turrets are protected by 9-inch armor. 2 illustrations. 1,200 words.—*The Marine Engineer and Naval Architect,* February.

The New 15,000-Ton Oil-Carrying Steamers for the Eagle Oil Transport Company.—Between July, 1911, and the date when the contracts now in hand will be completed, about 100 vessels will have been added to the world's oil-carrying fleet. Among the most noteworthy of the vessels under construction are the ten 15,000-ton oil carriers ordered by the Eagle Oil Transport Company, of London, which are to be employed for the transport of oil from the Mexican oil fields. The total number of oil tankers ordered by this company in connection with present developments is 19, including nine of 9,000 tons deadweight each, in addition to the ten already referred to. This is by far the largest order for tankers ever placed. All of them are being built under the superintendency of Messrs. Jacobs & Barringer, of London. Of the ten 15,000-ton vessels, Sir W. G. Armstrong, Whitworth & Co., Walker, and Messrs. Swan, Hunter & Wigham Richardson, Wallsend, are building three each, and Palmer's Shipbuilding & Iron Company, Jarrow, and William Doxford & Sons, Sunderland, two each. All of these vessels are generally similar except as regards details. The dimensions of Messrs. Armstrong's ships are: Length over all, 548 feet; length between perpendiculars, 530 feet; breadth extreme, 66½ feet; depth, molded, 41½ feet to shelter deck. The three vessels will be provided with propelling machinery of the quadruple expansion type by the Northeastern Marine Engineering Company, Wallsend, having cylinders 28½ inches, 41 inches, 58 inches and 84 inches diameter with a stroke of 54 inches and capable of propelling the vessels when laden with 15,000 tons deadweight at a speed 11¼ knots on a mean draft of 28 feet. Steam will be supplied by four cylindrical boilers designed for a working pressure of 220 pounds. The vessels are being built on the Isherwood system of longitudinal framing having a complete shelter deck. 3 illustrations. 1,100 words.—*The Shipbuilder,* February.

Interim Report of Committee on Boats and Davits.—A brief account is given of the findings of the departmental committee appointed to advise the Board of Trade as to the most efficient arrangements for stowing and launching lifeboats and for embarking passengers and crew, as to what extent mechanical propulsion should be adopted in such boats and as to whether rafts should be substituted in parts for boats. The committee is unanimous in recommending: (1) No limitation as to longitudinal position should be placed on the fitting of davits aft. (2) The most satisfactory arrangement is to stow an open boat attached to each set of davits. If that does not give sufficient boat accommodation, a decked boat should be stowed underneath each of a sufficient number of the open boats which are attached to davits. If this does not give sufficient accommodation the number of open boats carried may be reduced so that it may be possible to stow three decked boats under a set of davits. (3) Decked lifeboats may be stowed three in height, one above the other, under a set of davits, providing that certain conditions are complied with as to the support and means of launching the boats. (4) Further lifeboats, opened or decked, may be carried inboard immediately alongside the boats and the davits, provided that no more than six boats in two tiers of three each are so placed as to be served by one set of davits with the reservation that if it is not practicable in existing ships to fit the number of davits required no more than five boats shall be served by any one set of davits, with the reservation that if it is not practicable in existing ships to fit the number of davits required, no more than five boats shall be served by any one set of davits. When more than three boats are served by one set of davits there must be some approved means for lowering the boats in turn and rapidly. (5) In foreign-going ships in which the boat accommodation is so large that it is necessary to carry boats not actually attached to or not under other boats actually attached to davits, pontoon rafts of an approved pattern should be allowed in substitution of the above-named boats not actually attached to or not under other boats actually attached to davits, provided that the total number of persons for whom accommodation is provided in this form does not exceed 25 percent of the total number of persons the vessel is certified to carry, or the total number of persons on board, whichever is the greater. Further notes explanatory of the findings of the committee are included in this article. 1,800 words.—*Engineering,* Jan. 10.

The Brazilian Battleship Rio de Janeiro.—The design of the Brazilian battleship *Rio de Janeiro,* launched recently from the Elswick Works of Sir W. G. Armstrong, Whitworth & Co., Ltd., was evolved after two different proposals had been considered. One of the proposals was put forward by Admiral Duarte Huet de Bacellar, chief of the Brazilian Naval Commission in England, a man who has done much towards the improvement of the Brazilian navy and has naturally made a close study of the influence of tactics on ship design. The other design was by Mr. J. R. Perrett, the naval constructor of the Armstrong Company. Neither of these schemes was accepted, but a third design was ultimately evolved from the discussion of the alternative designs and the consideration of experience with the previous Brazilian dreadnoughts, the *Minas Geraes* and the *Sao Paulo.* In this article are shown plans of these three designs. Admiral Bacellar's design embodied the use of eight 16-inch guns placed in four barbettes, two of them forward and two aft, all on the centerline of the ship. In addition, six 9.4-inch guns were mounted in twin barbettes, two amidships to fire on either broadside, and two on each beam. This disposition of armament gives a broadside fire of eight 16-inch guns, four 9.4-inch guns, as well as seven 6-inch guns within an armored citadel. For ahead fire there are four 16-inch and four 9.4 inch guns and a corresponding astern fire apart from the 6-inch guns. Mr. Perrett, on the other hand, in his alternative design, held to the principle of unification of caliber, proposing either 15-inch or 16-inch guns. On account of the large caliber, the number of guns was reduced to ten, all of which were located in the turrets on the centerline of the ship, two forward and two aft, with one turret amidships, firing on either broadside. In Mr. Perrett's design the length and displacement of the ship were slightly greater than in the design submitted by Admiral Bacellar. As far as armor is concerned, there was little difference. In the *Rio de Janerio,* as now being built, fourteen 12-inch guns mounted in twin turrets on the centerline of the ship form the main armament. There are twenty 6-inch and ten 3-inch guns, besides three 21-inch torpedo tubes. The vessel is 668 feet long over all, 632 feet long between perpendiculars, 89 feet beam and 27 feet draft, with a displacement of 27,500 tons. The designed power for 22 knots is 32,000. The main broadside waterline armor is 9 inches in thickness for a length of 356 feet amidships and is continued forward and aft, being reduced in thickness first to 6 inches and ultimately to 4 inches at the extreme ends. The main belt is 13 feet 6 inches wide amidships and there are two strakes of 6-inch armor inclosing the citadel, making the total depth of the side armor amidships 28 feet. The *Rio de Janeiro* marks a distinct improvement on the *Minas Geraes* and *Sao Paulo* in respect to the distribution of armor. At the same time the under water structure has been very effectively subdivided, there being seventeen main bulkheads in addition to many subdivisions and watertight flats, making in all 365 watertight compartments. The *Rio de Janeiro* is fitted with Parsons turbines driving four shafts each with one propeller. Steam is supplied by 22 Babcock & Wilcox boilers, located in three boiler rooms, two forward and one aft. The auxiliary machinery room, as well as two magazines, separates the second and third boiler rooms. The boilers are arranged to work with oil fuel as well as coal. The coal bunkers are arranged on each side of the ships within the outer screen. Their capacity at normal draft is 1,500 tons and at full load 3,000 tons, while 500 tons of oil fuel is carried in the double bottom. The main propelling machinery is placed in three separate watertight compartments. One high-pressure ahead and one high-pressure astern turbine is placed in each wing engine room, and two low-pressure ahead turbines in which are incorporated the low-pressure astern turbines are placed in one engine room in the center of the ship between the wing engine compartments. The turbines are designed to develop at least 32,000 shaft horsepower when working at a steam pressure of 170 pounds per square inch and at about 320 revolutions per minute. The working pressure of the boilers is 250 pounds per square inch, the combined heating surface 74,800 square feet, and the grate area 2,150 square feet. The launching weight of the ship, including the cradle, was 12,400 tons. 16 illustrations. 4,600 words.—*Engineering,* Jan. 24.

Institute of Italian Naval and Mechanical Engineers.—At the recent meeting of the Italian Institute of Naval and Mechanical Engineers, General Cuniberti presented a paper on the deficiency of protection in dreadnoughts, in which he deplores the present tendency of sacrificing armor protection of battleships to the development of gun power and speed. It is the author's opinion that more attention should be given to the more thorough protection of the vital parts of the ship by using heavy armor to cover a more restricted zone than is the current practice. To spread a thickness of 12 inches of armor over more than a limited area is rendered practically impossible by the excessive displacement which would ensue, and, according to General Cuniberti, such protection would be unnecessary at the extremities of the vessel. Another paper of particular interest to naval engineers was presented by Colonel Rota on the proper placing of engines in battleships. Colonel Rota is a strong advocate of division and segregation in machinery arrangements. The hull, he insists, should be

built in autonomous zones, each containing the driving apparatus with the various classes of mechanism necessary for the service of the ship. A plan of a high speed vessel was brought forward in which there are three engines and three groups of boilers, each group of boilers being dedicated to the exclusive service of its corresponding engine. Complete independence is here combined with higher efficiency on account of the shorter length of the steam pipes, while a uniformly distributed coal consumption assures constancy in the trim of the ship. To prove his point still further, Colonel Rota illustrated the application of his theory of alternate boiler and engine sections to such ships as the *Venedetto Brin*, *S. Giorgio* and *Roma* without changing the arrangement of their artillery, while other plans were presented, showing the application of his system to various other designs of battleships.

A paper on the "Standardization of Propelling Machinery in Battleships," by Captain Fea, emphasized the enormous wastes which are occurring in the attempt to utilize so many different types of boilers, engines and auxiliaries for ships of similar designs and types. The evils of the present system are only too evident, as this great variety of types increases to an immense extent the difficulty and cost of repairs and changes which are continually necessary. In the matter of boilers only two countries have set a straight course for themselves, and compel manufacturers to follow in the search for a uniform and practically perfect steam generator. These two—Germany and Austria—have settled on standard types of boilers, Germany choosing the Schultz and the Austrians the Yarrow type. In general, two types of boilers have emerged to-day from the phalanx of theories and failures; these are the Yarrow, or Odero-Blechynden, with three drums and almost vertical tubes, and the Babcock & Wilcox, with single drum and tubes almost horizontal. Both of these types possess the following advantages indispensable to navy boilers: simplicity of construction and working, and elasticity in working and high thermal efficiency. The author has strongly urged the adoption of a universal type of boiler common to both battleships and torpedo boats. The American plan of using horizontal tube boilers on large ships and vertical tube boilers on the torpedo fleet seems to him inferior to the German method of adopting for every type of ship a uniform type of boiler with tubes all of equal diameter and thickness. Captain Fea also brought up the question of pushing unification still further so as to obtain a single boiler which should represent an element common to the generating plant of any ship. The author then proceeded to discuss the application of his scheme to turbines. The most suitable turbine for warships was without question working on a mixed system with impulse in the high-pressure and reaction in the low-pressure. The advantages of the mixed type of turbine include good thermal efficiency, extreme simplicity, distribution of the engine over two or three shafts, small space occupied and adaptability to any type of vessel. It is also suggested that eventually a standard type of turbine might be developed long these lines which would be suitable for all battleships.

A paper of exceptional importance, on account of the tangible results obtained by the author, was the description by Major Nino Pecoraro of the experiments conducted by himself and Cav. Peragallo during the last year in the Froude basin at the Spezia Arsenal, with a view to defining and tabulating the action of the Frahm anti-rolling tank. The experiments may be divided into two groups: (1) Experiments on models with a view to ascertaining the action of the tanks in calm weather. (2) Experiments with the navipendulum for the same purpose in a rough sea. In the first experiments the water in the tanks was carefully noted: The variation of opening for the passage of water and air; the period of oscillation of the ship; the volume of water in the tanks and the position of the tanks. The investigation was most thorough and the results are presented in this article most clearly with the aid of diagrams and tables. The second series of experiments with the navipendulum were to determine the conditions of rolling in a ship with or without bilge keels and tanks, and were made on the basis of a system of waves whose lengths and periods were gradually increased and whose height and length were proportioned according to the laws usually observed in nature. The efficiency of Frahm tanks was conclusively proved by the above experiments, which had also demonstrated that this efficiency was extremely high when approaching the critical conditions of synchronism, under which conditions it seemed considerably superior to that of rolling keels of the largest dimensions possible in practice. 30 illustrations. 12,400 words.—*The Engineer*, Jan. 24 and 31 and Feb. 7.

The Curtis Turbines of the Scouts Marsala and Mino Bixio.—By Commr.-Ingr. Vittorio Malfatti. The title of this article implies simply that a description of the Curtis turbines for the two scouts named is given. Nevertheless, the article contains a very complete resumé of the application of Curtis turbines to warship propulsion. Particulars are given of almost every Curtis turbine installation which has been made on the naval vessels of any nation. The first application was that on the United States scout cruiser *Salem*, where the turbines developed 16,000 shaft horsepower at 350 revolutions. The next installation in the United States navy was on the battleship *North Dakota*, where two turbines were fitted, each designed to develop 12,500 shaft horsepower at 245 revolutions. The *North Dakota* was followed in the course of about a year by the three destroyers, the *Sterret, Perkins* and *Walke*, each of which was fitted with two Curtis turbines. Those of the *Sterrett* developed 12,789 shaft horsepower on trial at a speed of 631 revolutions. The other two boats gave similar results. This constituted the first application of Curtis turbines to small warships, and they were characterized by a comparatively small diameter and by a high speed. A further application was that on the United States destroyer *Henley*, where two Curtis turbines were installed, each designed to develop 5,500 shaft horsepower at 585 revolutions. These turbines were installed in conjunction with combined reciprocating engines connected to the turbine shafts by means of jaw clutches. A similar arrangement has been selected for two of the eight destroyers recently ordered by the United States navy. In the United States battleship *Nevada* two Curtis turbines are to be installed, developing a total of 26,500 shaft horsepower. The Japanese navy have in use at the present time Curtis turbines totalling 210,000 shaft horsepower. The Argentine dreadnoughts *Rivadavia* and *Moreno* are each fitted with three Curtis turbines developing together 45,000 shaft horsepower at a speed of 275 revolutions. The Italian scouts *Marsala* and *Mino Bixio*, which form the subject of this paper, are 431 feet long between perpendiculars, 42 feet 9 inches mean breadth, 13 feet 7 inches mean draft, 3,575 tons corresponding displacement, 22,500 shaft horsepower, 28 knots designed speed. A detailed description is given of the turbine engines for these ships. 2 illustrations. 3,200 words.—*Engineering*, Jan. 31.

H. M. Submarine Boat E-4.—An explanatory note containing meager details of the submarine boat E-4 is published in conjunction with two excellent photographs of the boat taken during a surface run. It is understood that the boat is 180 feet long, close upon 23 feet beam, having a submerged displacement approximating 800 tons. The surface speed of the vessel is about 16 knots, the heavy oil engines with which it is fitted having a brake horsepower of over 1,500. The boat is constructed by Messrs. Vickers, Ltd., Barrow-in-Furness. 2 illustrations. 170 words.—*Engineering*, Jan. 10.

New Books for the Marine Engineer's Library

Calculations for Marine Engineers

REVIEWED BY PROFESSOR HERBERT C. SADLER*

Calculations for Marine Engineers (being Part I of Griffin's *New Guide to the Examinations for Marine Engineers*). By R. A. McMillan, B. Sc., Wh. Ex. Size, 5½ by 8⅜ inches. Pages, 336. Illustrations, 3. London, 1912: Charles Griffin & Co., Ltd. Philadelphia, 1912: J. B. Lippincott Company. Price, $3 net.

Within the past decade there has been a steady increase in the amount of scientific knowledge demanded of the seagoing engineer, and the object of the present book is to cover, in detail, the various problems relating to marine engineering which form the basis for the British Board of Trade examinations for first and second class engineer's certificates. The volume forms Part I of the complete work, Part II of which will appear later. The book is divided into sections representing the scope of the examination questions, and includes the following: (1) General arithmetic. (2) Mensuration. (3) Problems relating to steam, heat, etc. (4) Some general calculations relating to marine engine operation. (5) Mechanics.

In the first two sections the author has very wisely chosen problems in arithmetic and mensuration from those which bear directly upon marine work. The money and practice computations are, however, entirely in English units. The problems in heat, steam, combustion, horsepower, etc., are well arranged and cover the field of knowledge required by the seagoing engineer very thoroughly. The fourth section contains a somewhat varied collection of calculations ranging from the pressure upon a crank pin to the computations for propellers, salinometers and displacement of ships. The part devoted to the engine itself in this section is somewhat meager and might better have been placed in the second section, where, under the head of Mechanics, the design of some of the principal parts is discussed. The section dealing with boilers and riveted joints is well illustrated by numerous problems, and the appendix contains several examination papers and questions, reference being made in each case to certain parts of the text which will help in the solution of the same.

The principal criticism that can be made of the book is in connection with the arithmetical work and results of the various problems. The author has carried out every answer to a degree of accuracy (?) which can only be designated as absurd. When one considers the data upon which many of the problems are based, and which in all probability do not come within one or two percent of the truth (in some cases even more), the absurdity of carrying out the result to one ten-thousandth of 1 percent is evident. The labor involved is entirely wasted, particularly as most of the problems are of an eminently practical nature. Such examples lead to a wrong conception of what accuracy really is. Perhaps the most glaring case occurs on page 177, where the student is told to divide 1194.22771776 by 1870.22771776, in a problem which relates to propellers—of all things! One or two other examples may be given as illustrations: Page 55, percentage of ash obtained by weighing ashes in baskets, 4.47704 percent; Page 89, capacity of a cask, 52.26875 gallons; Page 95, weight on a safety valve, 382.0978854 pounds; also see Page 269; horsepower, Page 136, 674.25018; Page 165, length of ship, 206.1334 feet.

It is to be hoped that in future editions the author will ruthlessly draw his pencil through all figures beyond the first or second decimal place, as it is hardly conceivable that a practical engineer, or even a trained experimenter with the most delicate apparatus available, would be certain of measuring to one part in four thousand million.

It is also a pity in these days of the decimal system that the author helped to perpetuate the cumbersome units of tons, hundredweights, quarter pounds, and sometimes decimals of a pound, when tons and decimals of a ton are amply sufficient, particularly, for example, in making *an estimate* of the amount of coal in a bunker.

Perhaps, however, the author is not to blame for the above if such things are insisted upon by the Board of Trade Examiners; but if the latter are at fault, the sooner attention is called to such a state of affairs the better.

On the whole, however, the work should prove of great assistance to engineers studying for the various certificates. The numerous problems throughout the work and in the appendix cover the ground very satisfactorily, and in nearly all cases the various steps in the solutions are clearly stated and easy to follow.

The Navy League Annual

The Navy League Annual. Sixth Edition. Edited by Alan H. Burgoyne, M. P. Size, 5½ by 8½ inches. Pages, 392. Numerous illustrations. London, 1912: John Murray. Price, 5s. net.

The present volume is the sixth year of issue of the *Navy League Annual.* As pointed out by the editor in the Foreword, the past year has witnessed a noteworthy progress in naval develpoment. The size of battleships has increased, in one case at least, beyond 30,000 tons. Fuel oil has become an important factor in all armored vessels. Triple gun turrets are in some ships replacing the old two-gun turret arrangement. Destroyers have increased in size to over 1,000 tons, and seagoing submarines with a surface speed of 20 knots have been developed. Furthermore, a new element has been introduced in naval warfare, and that is the conquest of the air. To deal with such a complicated problem as the analysis of naval development under such circumstances, the editor has chosen wisely in securing the aid of specialists for discussing the different subjects which enter into the problem.

The book is divided into three parts. Part I contains, first, a chapter on the progress of the British navy. Then comes a chapter on the progress of foreign navies, and finally a chapter on comparative naval strength and a short glossary of common naval terms. Part II contains nine articles on special subjects, contributed by persons closely identified with the special subjects treated. In the first chapter of Part II, for instance, the position of Great Britain in the Mediterranean is discussed by Mr. George Lloyd, M. P., whose wide knowledge of international politics enables him to present with authority one of the most urgent national problems of the day. Other articles by Mr. Gerard Fiennes, Mr. Hector Bywater and Mr. Jean B. Gattreau deal with such subjects as Imperial Strategy, The Future of the French Navy and German Naval Progress. There are also contributions from Mrs. Richard Longland, Capt. Stanley W. Beeman and Marteau, but the two articles which are of special interest to engineers in this part of the book are the one on Recent Progress in Naval and Marine Engineering, by W. Stoddart, editor of the *Naval Engineer Review*, and that on the Development of Ship-Type, by the editor of the *Annual.*

The article on Recent Progress in Naval and Marine Engineering is disappointing, in that it deals not so much with progress in the last few years as with the entire progress of naval and marine engineering since steam was introduced as a means of propulsion in marine work. The article is therefore rather a résumé of what is common knowledge to practically every marine engineer, and is of interest chiefly to the layman rather than of value to the engineer.

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The article on the Development of Ship-Type is of interest chiefly because it deals with a subject which is uppermost in the minds of naval architects and naval constructors. The author compares the development of ship-types in the building up of the present British navy, and points out the serious errors which were made by the Admiralty, as well as the directions in which valuable progress has been made. The author's idea seems to be not to develop the navy in a homogeneous and logically progressive series of units, so that the newer ships can be utilized in harmony with the older vessels, but to progress by leaps and bounds at every opportunity by producing a ship-type embodying all the valuable features of every type now in use into one single unit, regardless of cost or feasibility. The items which he would include in a proposed design are the highest speed, the most powerful armament and the heaviest armor that can be found anywhere afloat, regardless of the size of the vessel, the power required to drive her, or the expense necessary for her production. It seems to us that there are too many variants in the problem to admit of its treatment in such a summary manner, without considering the effect of every factor which enters into the problem. There is no doubt that the prime necessity of a capital ship is the most powerful armament that can be obtained together with adequate protection, but the necessity of extreme speed is at least a matter for debate, not to mention many of the other doubtful factors.

Part III contains 84 pages of tables showing the evolution of various ship-types and comparative tables of contemporary naval vessels of all classes. The tables are ingeniously arranged and are useful in comparing the naval strength of various nations.

List of Shipping

Bureau Veritas, 1912-1913, Repertoire General. Two volumes. Size, 10½ by 11 inches. Pages, steamers, 1,165; sailing vessels, 946. Paris, 1912: 8 Place de la Bourse, or London, E. C., 155 Fenchurch street. Price, complete, £3 3s. ($15); steamers, £1 15s.; sailing vessels, £1 10s.

This is the forty-third edition of the general list of merchant shipping of all nations issued annually by the Bureau Veritas. It is one of the most complete compilations of such statistics published. The general list contains the names of the vessels and their masters, the class, signals, rig, flag, tonnage, length, beam, depth, the name of the builders and date of building, the principal details of the propelling machinery, the name and residence of the owners and the ports of registry. The names of the vessels are arranged alphabetically, and in the list of steamers are included all motor vessels. In addition to the general list the volume devoted to steamers contains general statistics of each flag, statistics of steamers built, bought and sold in the principal countries during the year, a list of steamships of all nations, tables of changes of names, new steamers, etc., a list of steamers carrying petroleum in bulk, a list of cable vessels, an alphabetical list of iron and steel shipbuilders, arranged according to the nationality, an alphabetical list of steamship owners, arranged according to the nationality, with the names and gross tonnages of their steamers, and a list of all drydocks, etc., in all parts of the world. The volume devoted to sailing vessels is arranged in practically the same manner as that for merchant steamers, except that there are separate lists for the owners of wooden vessels and for the owners of iron vessels and a list of vessels with auxiliary engines.

Personal

Naval Constructor R. H. M. Robinson, U. S. N., has resigned from the navy to accept an important position with the Lake Torpedo Boat Company, Bridgeport, Conn.

George A. Dean, Jr., formerly superintendent of the E. J. Codd Company, Baltimore, Md., has resigned to become general superintendent of the Spedden Shipbuilding Company, of Baltimore.

H. Matteson, formerly of Matteson & Drake, is now associated with Cox & Stevens, naval architects, marine engineers and vessel brokers, 15 William street, New York City. Mr. Matteson is in charge of the commercial vessel brokerage department of this firm.

George B. Drake, naval architect, 17 Battery Place, New York City, has been appointed assistant manager of the marine department of the Texas Company, New York. A large part of Mr. Drake's private practice, which relates especially to the design of oil-tank steamers, barges and towboats, as well as vessels for both passenger and freight service, will be taken over by Martin G. Kindlund, naval architect and engineer, at the same address.

Changes in the personnel at the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., were announced recently as follows: F. P. Palen to be assistant general manager of the company; J. B. Weaver to be general superintendent of construction; J. W. Gray, assistant to the general manager; W. H. Benson, superintendent of hull construction; Neils Christiansen, superintendent of machinery; J. H. Lofland, assistant superintendent of hull construction. This order means a distinct promotion for each of those named and is now in effect.

Alec McNab, of the McNab Company, Bridgeport, Conn., sailed for Europe recently to look after the business interests of this company abroad.

William B. Dickson, recently one of the vice-presidents of the United States Steel Corporation, has been elected president of the International Steam Pump Company, succeeding the late Benjamin Guggenheim, who went down on the *Titanic*.

F. H. Allison has been appointed general purchasing agent, in charge of all office and factory supplies for the American Vanadium Company and the Flannery Bolt Company, Pittsburg, Pa.

Norman L. Snow has been appointed general sales manager of the Terry Steam Turbine Company, with headquarters at the home office of the company at Hartford, Conn. The New York district office of this company, at 90 West street, New York City, will continue, as heretofore, under the management of Frederick D. Herbert.

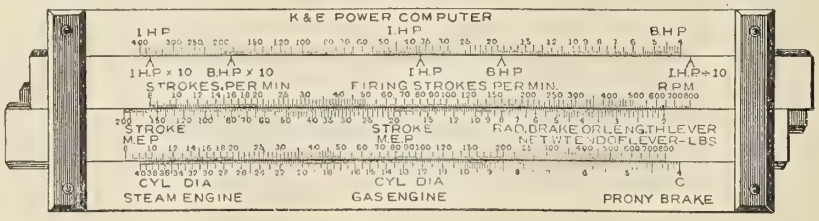
Obituary

John Fritz, one of the best-known mechanical engineers in the United States, died at Bethlehem, Pa., Feb. 13, at the age of 90 years. Mr. Fritz, familiarly known in the engineering profession as "Uncle John," was born Aug. 21, 1822, in Londonderry Township, Chester County, Pa. At the age of 16 he entered the mechanical field as an apprentice, and rapidly exhibited remarkable ability in the development of the iron industry. His first achievements were of a revolutionary character in the methods of making iron rails. Then he introduced important improvements in blast furnace practice. In 1860 he became general superintendent and chief engineer of the Bethlehem Iron Company, and in this capacity he turned his attention to perfecting the Bessemer process of making steel and improving the Siemens-Martin open-hearth process, as well as the design of rolling mills for plate and structural shapes. He was the originator of the method for manufacturing solid steel armor plate for naval construction. He was a member of all the principal engineering societies in this country and abroad, and was honored by many of the scientific societies of the world.

ENGINEERING SPECIALTIES

Power Computing Slide Rule

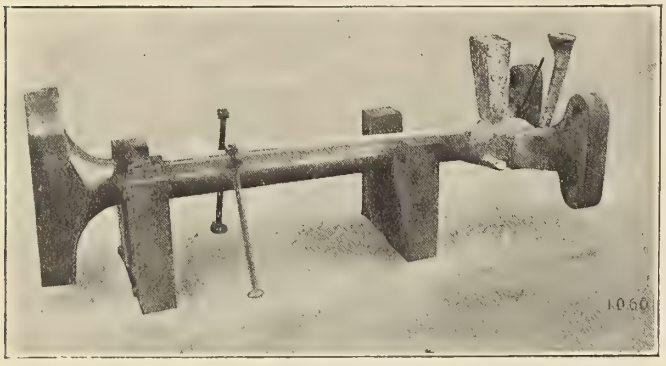
Keuffel & Esser Company, Hoboken, N. J., have recently developed a new slide rule for computing the power and dimensions of steam, gas and oil engines. The construction of the power computing slide rule is similar to that of the well-known Duplex slide manufactured by this company. The face of the rule, as shown in the illustration, carries five series of special



graduations to be used in determining brake horsepower, indicated horsepower, or principal dimensions of steam, gas and oil engines of any size. On the reverse face of the rule are engraved the *A*, *B*, *C* and *D* scales usually found on the Mannheim slide rule. The new rule measures 7½ inches by 2 inches, making it of convenient pocket size.

Unusual Quick Repair of a Connecting Rod on the Clyde Liner Iroquois Executed by the Thermit Process

A repair unique for despatch was executed for the Clyde Line last December when the connecting rod of one of the main engines of the *Iroquois* broke while the vessel was at sea. A wireless message was sent to the general offices of the company, and they immediately communicated with the Goldschmidt Thermit Company and arranged for a representative to meet the steamer upon her arrival. The steamer reached her pier at 11 P. M. Dec. 24, and the connecting rod was immediately removed, placed on a truck and taken down to the Jersey City repair shops of the Goldschmidt Thermit Com-



pany. Work was immediately started to prepare the broken piece for welding. To do this, part of it had to be cut away along the line of fracture so as to provide a space about one inch wide for thermit steel to flow into. The parts were then lined up and surrounded by a mold which provided for a reinforcement or collar all around the broken parts which was later to be filled with steel from the thermit reaction. This mold was completed early Christmas morning and the operation of preheating commenced. This was done with a compressed air gasolene (petrol) torch, which brought the broken sections inside of the mold to a bright red heat, at which time the charge of thermit was ignited in the crucible suspended over the pouring gate of the mold. The thermit reaction produces liquid steel in half a minute, and this steel being twice as hot as ordinary molten steel, will melt the metal that it comes in contact with and amalgamate with it to form a single homogeneous mass. In this repair, therefore, the thermit steel was tapped into the mold, where it amalgamated with the metal of the connecting rod and the whole cooled down into one solid piece.

As stated above, this work was completed on Christmas day and the rod was allowed to cool over night. On the morning of Dec. 26 the mold was dismantled, the weld trimmed up and the rod returned to the steamer. She was due to sail early in the afternoon of the 26th, and could have done so had she not been held up a few hours on account of cargo. No delay at all was occasioned by the repair of the connecting rod.

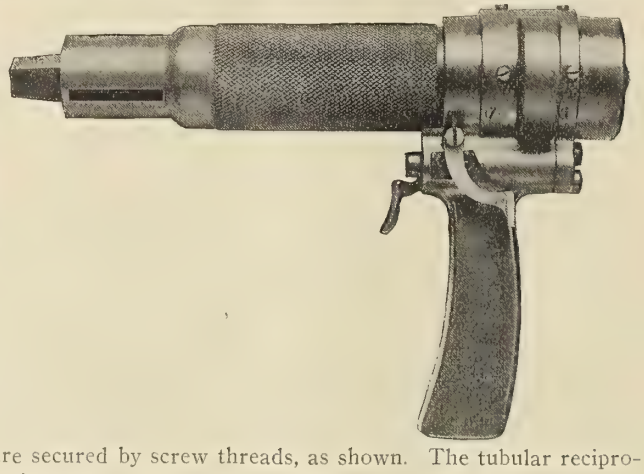
It may be of interest to our readers to know that two vessels of the Clyde Line, the *Apache* and the *Arapahoe*, have thermit welds on their stern frames. The *Apache* was welded July, 1905, and the *Arapahoe* in June, 1909.

The thermit process offers many advantages for repairs of this character, owing to the fact that the sections can be welded without their removal from the vessel and without keeping the vessel in drydock more than two or three days at the most. The saving in drydock charges is a very large item, and the fact that the vessel can be so quickly restored to service is another great advantage.

Condenser Packing Tool

H. G. Kotten Company, New York, has on the market a condenser packing tool which is operated by compressed air and is so designed that it winds the packing cord around a spindle and then pushes it into position around the condenser tube when the operator presses a finger and a thumb trigger, which control the two operations.

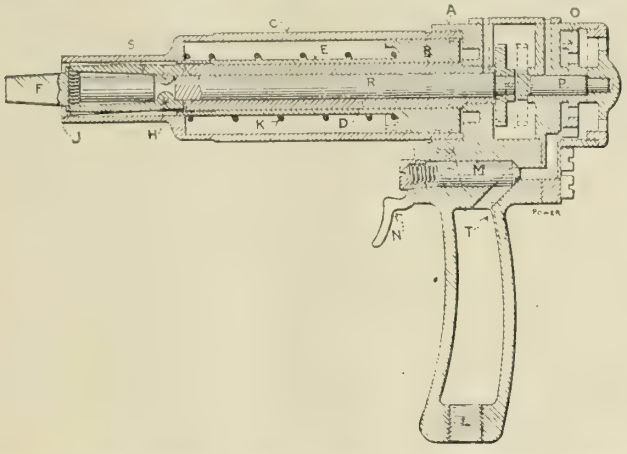
In the sectional view of the device shown, *A* represents the body part of the tool, which is integral with the handle. The barrel is made with a reduced outer end and the parts



are secured by screw threads, as shown. The tubular reciprocating plunger *E* is provided with a piston *B* which accurately fits within the barrel *C*. A rotary shaft fits within the inner guide tube and is provided with an enlarged journal bearing at its outer end. The end of this enlarged part is turned down into the form of a frustum of a cone, as indicated at *F*, and is provided with a shoulder which fits against the end of the tubes around which the packing is to be inserted. This en-

larged part also constitutes a cylinder around which the packing cord is wound before the tool is put into use. To secure this cord a longitudinal groove is provided in the body part in which is pivoted upon a pin *H* a longitudinal finger *J*. It is grooved at its outer end and has a spiral spring inserted in a hole, the arrangement being such that normally this finger is held at its outer end against the inner face of the small end of the barrel. The spiral spring *K* is for the purpose of returning the reciprocating plunger to its normal position after it has been actuated by the compressed air.

A longitudinal slot to the small end of the barrel constitutes an opening for the insertion of the packing cord. The air supply is conducted to the handle of the tube through a rubber



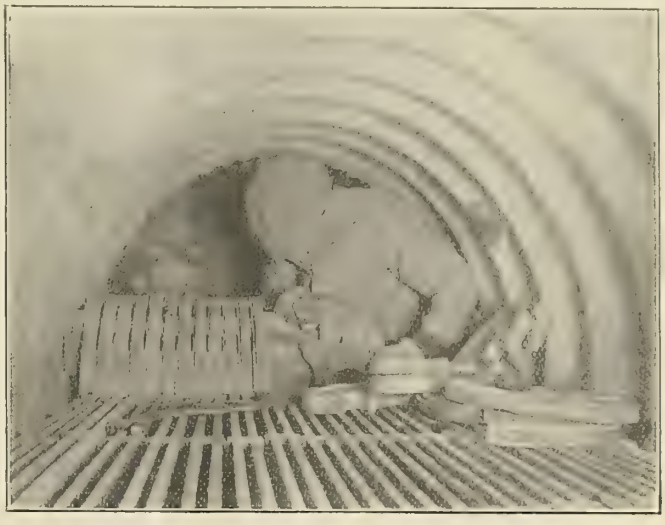
tube. In the bottom of the handle is an opening *L*, which runs to the body of the valve, where it is divided into two channels, one conveying the compressed air to the piston and the other to the driving motor. The valve *M* is held in a seated position by a spiral spring, and the valve is actuated by means of the trigger *N*.

The operative part of a rotary motor is shown at *O*. It is secured to the rear end of the breech of the tool and the shaft *P* actuates the rotating shaft *R* of the tool. A detachable cap is secured to the casing of the motor and is provided with a journal bearing. A pinion carried by the shaft *P* meshes with the gear wheel, which rotates on a bearing journal that is secured to the breech. Another pinion is carried by a shaft integral with the gear wheel and meshes with a gear wheel that is secured to the rotary shaft *R*. A second valve is kept seated by the pressure of a spring in the channel running to the rotor of the motor. This valve is operated by the lever *T*, which is worked by the pressure of the thumb. Air vents are provided for liberating the air after it has passed through the motor.

When using the tool one end of the cord is inserted at the outer end of the slot shown at the small end of the barrel. Air pressure is immediately admitted to the motor by merely pressing a trigger with the thumb. The motor rotates the spindle *S*, thereby drawing the cord through the opening and winding it around the spindle. The cord is then in a position to be forced on the tube end by the reciprocating plunger. The operator presses the finger trigger a number of times in succession until the cord has been driven home, the number of blows depending upon the density to be given to the packing. In this way the operator passes from one tube to another in quick succession. The average operator can easily pack a condenser at the rate of from 10 to 15 tubes per minute.

Wager Patent Improved Furnace Bridge Wall

An improved furnace bridge wall, which has been installed with satisfactory results on ocean-going and harbor tugs, ferryboats and by many of the large railroads and steamship companies, is made by Robert H. Wager, 100 William street, New York. This device was designed to provide at a very moderate cost a bridge wall which can be easily removed and replaced without sacrificing material. It is composed of gray cast iron bars with suitable air openings between. The back bridge wall casting is provided with suitable air openings to admit air freely from the ash pit to and around the bridge wall castings, and through openings in the bridge wall bars to the fire, in order to do away with the usual pile of dead fire against the bridge wall. The intermediate sections have formed at the crest of the bridge a series of openings by which air is admitted to mingle with the gases from the furnace as they pass into the combustion chamber, thus effecting their complete combustion and preventing gasing and excessive

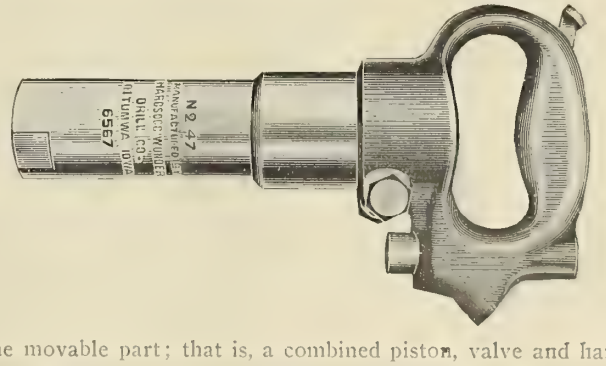


smoking. When in use the bars of the bridge are securely locked in place, but they are provided with means for readily removing them when necessary.

The illustration shows how easily the Wager improved bridge wall may be attached or detached to the bridge wall casting, whereby a single bar may be removed from any part of the bridge wall without disturbing the general assembly.

"Wonder" Chipping, Beading and Calking Hammer

The Hardsocg Wonder Drill Company, Ottumwa, Ia., manufacturers of "Wonder" rock drills, have placed on the market recently a chipping hammer which is made after the pattern of their air hammer rock drills. The hammer has only



one movable part; that is, a combined piston, valve and hammer. The particular advantage claimed for this hammer is that there is no live air used in returning the piston on the return stroke, and consequently there is a great saving in the air consumed over the old-style valve hammer. The hammers are made in three sizes, of 8, 10 and 12 pounds, respectively. The 8-pound hammer is suitable for calking 3/16-material, while the 10 and 12-pound hammers are for heavier work in proportion. They are made with either outside or inside latch.

SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

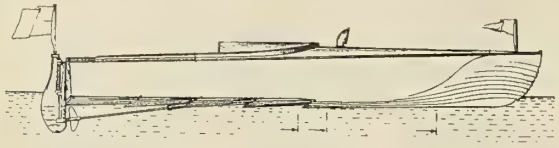
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

1,041,849. MOTOR BOAT. CHARLES H. MYERS, OF BUFFALO, N. Y.

Claim 2.—The combination of a boat including an upper main hull, and a lower auxiliary hull, and an approximately oblong skimming device rigidly connected with the boat and composed of a continuous series of detachable buoyant sections adapted to be floated into position and assembled one at a time. Nine claims.

1,050,517. HYDROPLANE BOAT. IRWIN CHASE, OF BAYONNE, N. J., ASSIGNOR TO ELECTRIC LAUNCH COMPANY, OF BAYONNE, N. J., A CORPORATION OF NEW JERSEY.

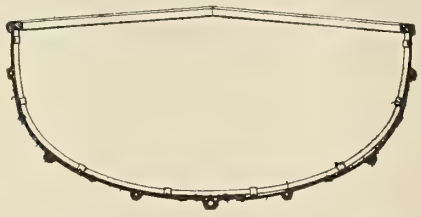
Claim 1.—A boat provided with a surface-skimming hydroplane having



a keelwise corrugated under surface devoid of transverse obstructions. Thirteen claims.

1,050,480. METALLIC BOAT CONSTRUCTION. ANDREAS P. LUNDIN AND EINAR L. M. SIVARD, OF NEW YORK, N. Y., ASSIGNORS, BY MESNE ASSIGNMENTS, TO ASTOR TRUST COMPANY, TRUSTEE, A CORPORATION OF NEW YORK.

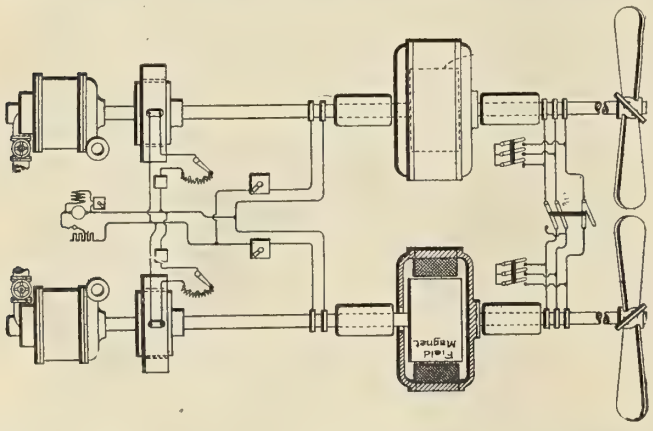
Claim 1.—In metallic boat construction, the combination with an outer metallic plating having a semi-circular groove depressed below its inner



surface at the longitudinal center line of the boat, and a pipe within such groove. Six claims.

1,047,858. TURBO-ELECTRIC PROPULSION OF VESSELS. ELIHU THOMSON, OF SWAMPSCOTT, MASS., ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

Claim 2.—In a system of ship propulsion, the combination with a pair of turbines, of revolving field magnets each driven by its respective turbine, a revoluble armature structure concentric with each field magnet, screw propellers each having a shaft carrying its respective armature



structure, an exciter supplying current to said field magnet windings, polyphase windings on said armatures, means for interconnecting the same, and means for holding stationary either of said revolving field magnets. Four claims.

1,043,915. APPARATUS FOR SUPPORTING AND LOWERING LIFE-BOATS. JOHN E. ERICKSON, OF CHICAGO, ILL.

Claim 1.—A device of the class described comprising two spaced supporting rails; a boat arranged between said rails and having studs at its ends resting upon said rails; means engaging said studs for moving said boat longitudinally of said rails; and boat-lowering means at the terminals of said rails. Twelve claims.

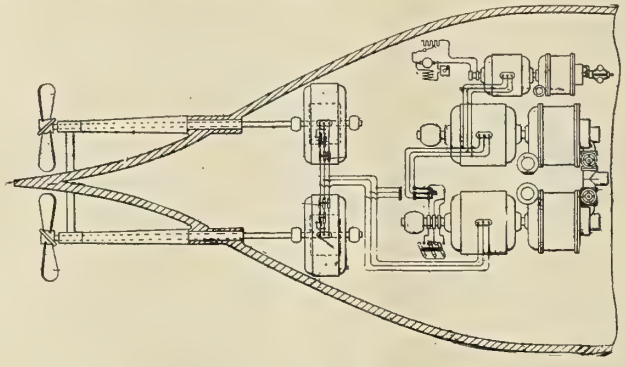
British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

14,962. BOAT RAISING AND LOWERING GEAR. P. R. ARNOTT, WESTCLIFF-ON-SEA.

This invention relates to davits, and consists in adapting a centrally disposed stanchion to serve as a stop for the boat when in-board. The davits, strengthened by members, are pivoted and are splayed to give an initial tendency to swing outwards. The falls are led from the boat hooks over pulleys to a winch provided with a foot brake. The pulleys are secured to a stanchion having a lipped plate which stops the boat. The inner chocks are secured to the davit members, while the outer ones are pivoted to the davits and are provided with tail-pieces which co-operate with fixed stanchions, whereby the chock is automatically brought into position and released as the boat is being either raised or launched.

28,512. IMPROVEMENTS IN SHIP PROPULSION. THE BRITISH THOMSON-HOUSTON COMPANY, LTD., CANNON STREET, E. C.

This invention relates to the propulsion of vessels by means of electric motors supplied with current from electric generators driven by high-speed economy turbine engines, the object being to take advantage of the economy of space, material and steam and to control the speed while preserving the high economical speeed of the prime mover. In the system of propulsion high-speed economy steam turbines drive polyphase



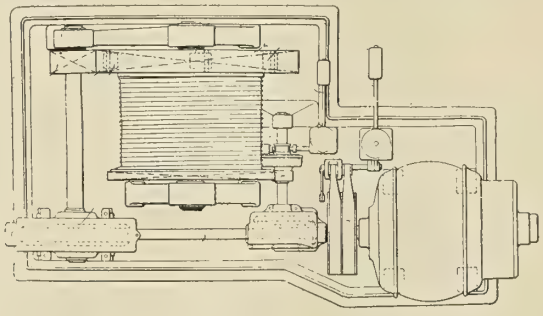
generators of the induction type supplying current to propelling induction motors, an auxiliary synchronous generator being connected to the stators of the generators for setting the phases, a variable speed turbine being provided for driving the auxiliary generator. The switches for short-circuiting the winding of the rotor of the generator and the double throw-over switch connecting either the slip rings or the leads, serve for connecting the main generator in parallel to the motors, and for connecting the main generators in concatenation.

26,983. IMPROVEMENTS IN ANCHORS. A. E. GILBERT, TOTTERIDGE, HERTS.

A stockless anchor having pivoted detachable arms constructed according to this invention, comprises a block to form the middle portion of the crown, and which carries opposite integral trunnions and elongated stop portions to engage the borings, the anchor arms, each formed with the counterparts of the trunnions and elongated portions, a shank being detachably fitted to the block within the double bore, and a coupling yoke is detachably connected to the anchor arms.

12,761. ELECTRIC BOAT HOISTS. SIR W. G. ARMSTRONG, WHITWORTH & CO., LTD., AND R. WRIGHT, ALL OF ELSWICK WORKS, NEWCASTLE-UPON-TYNE.

The following apparatus is designed to keep the slings taut as the boat rises and falls on the waves. The hoisting drum is driven from the motor through a shaft, worm pinion and ring pinion, the latter having pawls engaging ratchet teeth on the drum. The shaft, which is braked by bands, also drives through bevel gears a shaft on which is a



friction clutch. The clutch is normally held out by a weighted arm, which can be raised by a solenoid connected to the lifting and lowering controller. When lifting the pawls drive the drum, the clutch being out. When the controller is reversed, however, the ring is reversed and the drum can therefore rotate under the pull of the slings, but as the solenoid has put the clutch in, the motor is tending to drive the drum the reverse way, but only with a force small enough to be overcome when lowering the boat, but sufficient to hold the slings taut as soon as the boat is water-borne.